APPENDIX A

RECORD OF DECISION

Allied Chemical & Ironton Coke Site
Operable Unit Three
Tar Plant

Ironton, Lawrence County, Ohio

United States Environmental Protection Agency
Region 5

September 2007

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Part 1: The Declaration

Site Name and Location

The Allied Chemical and Ironton Coke Superfund Site (Site) is located in Ironton, Ohio (Lawrence County). The National Superfund Database Identification Number is OHD043730217.

Statement of Basis and Purpose

This decision document presents the selected remedial actions for operable unit three (OU3) of the Site, which is the Tar Plant. These are also the final remedial actions for the Site. The United States Environmental Protection Agency (U.S. EPA), in consultation with the Ohio Environmental Protection Agency (Ohio EPA), chose the remedies in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), 42 United States Code §9601 et seq., as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300, as amended.

Information used to select the remedial actions are contained in the Administrative Record file for the Site, which has been developed in accordance with Section 113(k) of CERCLA, 42 United States Code §9613(k). The Administrative Record file is available for review at the U.S. EPA Region 5 Records Center, 77 West Jackson Boulevard, Chicago, Illinois and at the Briggs Lawrence County Public Library, 321 South 4th Street, Ironton, Ohio.

Assessment of the Site

The response actions selected in this Record of Decision (ROD) are necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances, pollutants, or contaminants into the environment.

Description of the Selected Remedy

The Site is being addressed as three operable units (OUs) under the framework set forth in CERCLA. The remedial actions for operable unit one (OU1), the Goldcamp Disposal Area (GDA) were documented in the 1988 ROD. The remedial actions for operable unit two 2 (OU2), Coke Plant/Lagoon Area (CPLA) were documented in the 1990 ROD and three ROD amendments in 1995, 1997, and 1999. This ROD presents the selected remedial actions for OU3, the Tar Plant.

The Tar Plant is the third and final OU. Therefore, the selected remedial actions specified in this ROD will serve as the final remedial actions for the entire Site. The selected remedial actions will address chemically-contaminated soils, sediments, and soil vapor at the Tar Plant. U.S. EPA believes the response actions outlined in this ROD, if properly implemented, will protect human health and the environment. The selected remedial actions include:

- Soil: Ohio EPA-compliant solid waste cap with Institutional Controls (ICs)

  An Ohio EPA-compliant solid waste cap (or cover) will be installed over all contaminated portions of the Tar Plant (16-acre main plant parcel and 7-acre river parcel). The low-permeability cover system will create a physical barrier to direct contact with contaminated soils and would reduce or eliminate infiltration that can leach contaminants from soil into groundwater. ICs will be implemented to protect the integrity of the cap. An IC implementation plan will be developed as part of the design of this remedial action.

- Sediment: Combination of dredging, in-situ capping, and off-site disposal

  Contaminated sediment will be removed using dredging techniques appropriate for the sediment and river conditions at the time of work implementation. Turbidity control measures will be implemented to ensure minimization of the migration of suspended solids. Methods to dewater excavated sediment will be evaluated during the design phase of the remedy. Water generated during the dewatering process will be treated by the Site's wastewater treatment system, constructed originally for OU1 and OU2. Following dewatering, the sediment will be disposed of at an off-site approved landfill. Because of the technical limitations to dredging in a dynamic river system, some residual contaminated sediment may remain. Post-dredging sampling will occur and any residual contamination will be covered with either earthen materials (sand, gravel and/or cobbles), engineered materials (geosynthetics or marine mattresses), or a combination of these materials, to be determined during the design phase, taking into account the long-term use plans for the location.

- Air: ICs

  ICs will be established requiring the use of vapor barriers and/or sub-slab ventilation systems in any new construction buildings on the Tar Plant property. The ICs will also require health and safety measures to be implemented during any subsurface construction activities.

Statutory Determinations

The selected remedial actions are protective of human health and the environment, comply with federal and State of Ohio requirements that are applicable or relevant and appropriate to the remedial actions, are cost-effective, and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. The selected remedies herein do not satisfy the statutory preference for treatment as a principal element of the remedy because the soil and sediment do not constitute principal threats at the Site. However, there is dense non-aqueous phase liquid (DNAPL) within the groundwater, which is considered a principal threat waste at the Site, which is being addressed via the OU1 and OU2 RODs.

Because this remedy will result in hazardous substances, pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review, known as the five-year review, is required for the entire Site. Five-year reviews are required every five years from initiation of construction of the remedies. The five-year review for this operable unit, however, will be conducted in accordance with the schedule for the site-wide five year review. The next five-year review for the Site is required to be completed by September 13, 2009. The objective of these five-year reviews will be to confirm that the remedies are, or will be, protective of human health and the environment. If the selected remedies are found to be unprotective, then corrective actions to bring the remedies to a protective level will be taken.

ROD Data Certification Checklist

The following information is included in the Decision Summary (Part 2) of this ROD, while additional information can be found in the Administrative Record file for the Tar Plant:

a) COCs and their respective concentrations (see Section 7);

b) Baseline risk represented by the COCs (see Section 7);

c) Remediation (cleanup) goals established for the COCs and the basis for the goals (see Section 8);

d) How source materials constituting principal threats are addressed (see Section 11);

e) Current and reasonably anticipated future land use assumptions (see Section 12);

f) Potential land use that will be available at the Tar Plant as a result of the selected remedies (see Section 12);

g) Estimated capital, lifetime operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedies' cost estimates are projected (see Appendix B); and

h) Key factor(s) that led to selecting the remedies (see Section 10).

Support Agency Acceptance

Ohio EPA concurs with the selected remedies (Appendix C).

Authorizing Signature

9/20/07

Richard C. Karl, Director
Superfund Division
United States Environmental Protection Agency, Region 5

Date

Part 2: The Decision Summary

1.0 Site Name, Location, and Description

The Allied Chemical and Ironton Coke Plant Superfund site (Site) is located at 3330 South Third Street in Ironton, in the southwest quarter of section 30, T1N, R18 E, Lawrence County, Ohio (Figure 1). The Site is comprised of: the Goldcamp Disposal Area (GDA), also known as operable unit one (OU1); the former Coke Plant/Lagoon Area (CPLA), also known as operable unit two (OU2); and the former Tar Plant, also known as operable unit three (OU3). The entire Site encompasses approximately 95-acres, including portions of the adjacent Ice Creek. The GDA is a former sand and gravel pit used for disposal of tar plant waste and foundry sand. The CPLA is bordered on the south and east by Ice Creek. Near the southern end of Ice Creek, at the point where it empties into the Ohio River, lies the Village of Coal Grove. The Ohio River lies west of the former Tar Plant. Portions of the CPLA lie within the 100-year flood plain. Much of the Site area is covered by a fill that overlies the native soils.

The Tar Plant itself occupies approximately 27-acres in an industrially zoned section of Ironton, Ohio. The Tar Plant is bordered to the east by the CPLA, to the south by Ironton Bulk Terminals Inc., to the west by Norfolk-Southern Railroad tracks, beyond which is the Ohio River, and to the north by the GDA. Except for an 11-acre parcel located within the Ohio River floodplain (between the railroad tracks and the Ohio River), the Tar Plant lies on a relatively flat alluvial terrace above the 100-year flood level of the Ohio River [approximately 547-feet above mean sea level (msl)].

One small office building, an open air shed, above-ground water conveyance lines, two groundwater extraction wells, and a significant number of monitoring wells are currently located on the Tar Plant property. The land is covered by paved or gravel roads, demolition debris, and vacated railroad beds. The approximate 16-acre main parcel is secured by a 6-foot chain-linked fence. The Site layout is shown in Figure 2.

2.0 Site History and Enforcement Activities

2.1 History of Tar Plant Activities

The Tar Plant was constructed across Third Street from the Coke Plant in 1945. Honeywell, as the Barrett Division of the Allied Chemical and Dye Company and later as the AlliedSignal Engineered Materials Sector, operated the Tar Plant (also known at the Honeywell Coal Tar Refinery) from 1945 to December 2000. In 1988, the creosote product line was sold to KMG-Bernuts, followed by the acquisition of the various carbon material product lines by Reilly Industries in 1999, and the sale of the naphthalene product line to Recochem in 2000.

The Tar Plant manufactured products from the crude tar produced in the coking process. During its period of operation, the Tar Plant contained 124 above-ground storage tanks and process tanks varying in approximate size from several hundred to 750,000 gallons, numerous ancillary buildings used for storage, maintenance operations, offices, lockers and showers, and a laboratory. Honeywell began decommissioning activities on May 29, 2001, pursuant to a March 2001 Site Management Plan completed in accordance with the Cessation of Regulated Operations regulations, Chapter 3752 of the Ohio Revised Code and Chapter 3745-352 of the Ohio Administrative Code. With the exception of an office building located near the main entrance, all structures were removed during decommissioning activities completed by December 2003. The Site layout prior to decommissioning activities is shown on Figure 3.

The products manufactured at the Tar Plant included: phthalic anhydride, pitch, creosote, naphthalene, anthracene, and carbolic acids. The process wastes included: anthracene residue, anthracene salts, phthalic anhydride residue, and coal tar pitch scrap. Some of the process wastes from the Tar Plant were disposed in the adjacent sand and gravel pit (i.e. the GDA) until 1978 when the GDA was shut down. Process wastewater was treated at the wastewater treatment plant located on the property with the CPLA, and then discharged to the Ohio River through two permitted outfalls, 001 and 002. Outfall 002 was taken out of service in 2001.

When the Allied Chemical and Ironton Coke facility was placed on the National Priorities List (NPL) in 1983, the Tar Plant was still an operating and permitted facility under the Resource Conservation and Recovery Act (authorized to the State of Ohio). The remedial investigation (RI) for OU1, the GDA, began that same year under an Administrative Order on Consent (AOC). That study, completed between 1983 and 1998 focused on this area, which received wastes from the Tar Plant and on OU2, the lagoons that received process wastewater and solid waste from the coke plant. In summary, the GDA was designated OU1 and the CPLA was designated OU2. Two Records of Decision (RODs) have been issued: September 1988 for OU1; and December 1990 for OU2. Three OU2 ROD amendments were issued: 1995; 1997; and 1999.

The 1997 ROD Amendment for the CPLA required excavation and offsite disposal of soil from three localized areas on the Tar Plant. Remedial construction was completed at OU1 in 1995 and at OU2 in 2001. Site-wide groundwater pumping and treatment, and operations and maintenance activities are ongoing. Two of the groundwater extraction wells (WE-1800 and WE-618) are located on the Tar Plant. Product recovery [dense non-aqueous phase liquids (DNAPLs)] is also performed in WE-618.

Specific components of the OU1 remedy included:

- Construction of a low permeability slurry wall encircling the GDA;
- Creating an inward groundwater gradient within the slurry wall boundaries;
- Installation of a multi-media RCRA-compliant cap over the surface of the GDA;
- Treating groundwater extracted from inside and outside of the slurry wall at a new on-site treatment facility;
- Municipal water hook-up for in-plant potable and sanitary uses at Ironton Iron Inc.
- Monitoring Site groundwater;

- Securing the Site from unauthorized personnel and implementation of deed restrictions; and
- Non-aqueous phase substance (NAPS) investigation and implementation of the EPA approved remedy, if different than the present containment alternative.

Specific components of the OU2 remedy included:

- Incineration of approximately 122,000 cubic yards of lagoon waste materials, and on-site reuse of the waste heat generated during incineration (Waste Fuel Recovery);
- In-situ bioremediation of approximately 457,000 cubic yards of lagoon waste material;
- Prepared-pad surface bioremediation of approximately 40,000 cubic yards of contaminated soil materials;
- Pumping and on-site treatment of groundwater;
- Monitoring of groundwater down gradient of Ice Creek and preparation of a contingency plan;
- Fencing, security, and deed restrictions; and
- Evaluation of the effectiveness of in-situ bioremediation, with a contingency for development of an alternative remedial action for Lagoons 1 through 4.

As previously stated, the OU2 CPLA ROD was amended three times: July 31, 1995, September 4, 1997, and September 30, 1998. The ROD amendments allowed the following modifications:

- Revised the clean-up standards for benzo(a)pyrene and dibenz(a,h) anthracene in groundwater for the GDA and CPLA;
- Excavation and storage on-site for eventual treatment or placement into the lagoon area of 135,000 cubic yards of soils found to be contaminated with low levels of PAHs during the design phase;
- Replaced prepared-pad bioremediation of 40,000 cubic yards of soil with off-site disposal in an approved landfill;
- Replaced in-situ bioremediation of 457,000 cubic yards of soil in Lagoons 1 through 4 with hot spot excavation and wetland development; and
- Replaced incineration of Lagoon 5 materials with recycling, treatment, and/or disposal of the KO87 listed waste in an approved off-site hazardous waste facility and the use of the remaining material, excluding debris, as an alternative fuel.

2.2 History of Federal and State Investigations

The site assessment involved the entire Allied Chemical & Ironton Coke facility. At the Tar Plant, suspected sources of impact included: (1) the material transfer lines that connected the coke plant and the barge dock on the Ohio River, or used for transfer of finished tar product to storage on the Tar Plant; (2) miscellaneous leaks and releases in the process and material handling and storage areas of the Site; and (3) three underground storage tanks.

A series of groundwater sampling events were conducted and various concentrations of cyanide, phenolics, ammonia, benzene, and chloride were detected. Other components were detected but considered not to be as prevalent. Two areas of concern were identified: the anthracene production unit and an area near monitoring well T-13 D (see Figure 2 for location of monitoring well T-13 D).

Surface water samples were also collected from the Ohio River adjacent to the Site, and upstream and downstream from the Site. The sampling parameters included ammonia, total cyanide, phenolics, benzene, and naphthalene. Cyanides, phenolics, benzene, and naphthalene were detected in samples collected adjacent to the Site. No significant change in the river water quality near the Site was noted.

2.3 History of CERCLA Enforcement Activities

Tar Plant Summary

The Tar Plant was closed and operations ceased in December 2000. Closure of the plant was covered under the State of Ohio Cessation of Regulated Operations regulations. Honeywell began the decommissioning activities in May 2001 pursuant to a site management plan approved by Ohio EPA and U.S. EPA. While contaminated groundwater is already addressed by the current site-wide groundwater pump and treatment system, contaminated soil beneath the former Tar Plant structures remained to be characterized and addressed. U.S. EPA issued an AOC to Honeywell on August 22, 2003 for performance of a remedial investigation and feasibility study (RI/FS) at the Tar Plant.

By December 2003, Honeywell completed all significant decontamination and demolition work at the Tar Plant. In addition, Honeywell submitted its first deliverable for the RI/FS; the technical letter report which provided a synopsis of all data previously collected as part of OU1 and OU2 that was relevant to the Tar Plant.

In June 2005, Honeywell submitted a draft Tar Plant RI report. However, this report documented areas at the Tar Plant that required further investigation. Therefore, an amendment to the work plan was submitted by Honeywell in February 2006, and after review and approval by U.S. EPA and Ohio EPA, Honeywell conducted additional field work. This field work (also known as the Phase Ia work) was initiated in February 2006 and was completed in June 2006. Honeywell submitted a draft RI report on the Phase Ia work, which was revised per comments from U.S. EPA and Ohio EPA. The final RI reports covering both Phase I and Ia were approved by U.S. EPA, in consultation with Ohio EPA, in March 2007.

OU1 and OU2 and Related Tar Plant Information

Allied prepared a closure plan for the OU1 GDA in 1977- 1980 and submitted it to Ohio EPA. Closure work included a groundwater investigation, removal of standing liquids, and placement of a clean soil fill. Allied applied for a Resource Conservation and Recovery Act (RCRA) Interim Status permit for the lagoons in 1981. In 1982, Allied ceased operations at the lagoons because no permit was issued (the application was filed late and facility failed to achieve RCRA Interim Status). Also in 1982, Ohio EPA requested that the facility be listed on the NPL. The Allied Chemical and Ironton Coke facility was proposed for the NPL in December 1982. The facility was placed on the NPL in September 1983.

Negotiations between Allied (former to Honeywell), U.S. EPA, and Ohio EPA concerning performance of the site-wide RI/FS by Allied under Agency oversight resulted in an Administrative Order on Consent (AOC) for the RI/FS which was signed on April 13, 1984. The facility was divided into two operable units: Goldcamp Disposal Area (GDA or OU1) and Coke Plant/Lagoon Area (CPLA or OU2) in 1986.

As specified in the summary, above, U.S. EPA issued an AOC to Honeywell on August 22, 2003 for performance of an RI/FS at the Tar Plant. The Tar Plant was designated as OU3 of the Site when the Tar Plant was closed pursuant to the Ohio EPA RCRA regulations in 2000. Honeywell submitted a Draft RI Report to U.S. EPA and Ohio EPA on June 8, 2005. Additional data gaps were noted and the agencies required additional data collection. This phase 1a work was completed and a revised RI Report (called the Phase 1a RI Report) was submitted to the agencies on April 26, 2007. Honeywell submitted a Draft FS on April 26, 2007 and an FS addendum on June 15, 2007.

OU1 Enforcement Activities

A Unilateral Administrative Order (V-W-89- C-007) (UAO) was issued to Allied and AMCAST for performance of Remedial Design and Remedial Action (RD/RA) pursuant to the ROD for OU1 in 1989. The OU1 Remedial Design (RD) was completed in 1994, while the OU1 Remedial Action (RA) was completed in 1995.

OU2 Enforcement Activities

The OU2 Unilateral Administrative Order (UAO) issued to Allied for performance of OU2 RD/RA was signed in July, 1991. An AOC for a Removal Action, providing for the removal of tanks at the Coke Plant was signed in March 1987.

OU3 Enforcement Activities

The OU3 AOC (V-W- 03-C-755) was issued in August 2003 for performance of the RI/FS.

3.0 Community Participation

These community participation activities during the remedy selection process meet the public participation requirements in CERCLA §121 and the NCP 40 CFR §300.430(f) (3).

The RI/FS Report and Proposed Plan for the Tar Plant were made available to the public on July 13, 2007. Copies of both documents can be found in the Administrative Record (AR) file at the U.S. EPA Library in Region 5 and in the repository at the Briggs Lawrence County Public Library, 321 South Fourth Street, Ironton, Ohio. The notice of the availability of these two documents was published in the Ironton Tribune on July 15, 2007. A public comment period was held from July 16, 2007 through August 14, 2007. U.S. EPA's response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision (Appendix A).

3.1 Fact Sheets

Numerous fact sheets were prepared during the planning and implementation of the RI/FS, RD and RA for all the OUs. These fact sheets were placed at the Site's repository and distributed to community members on the mailing list.

3.2 Local Site Repository

The purpose of the local repository is to provide the public a location near the community to review and copy background and current information about the Site. The repository is located near the Site at Briggs Lawrence County Public Library, 321 South Forth Street, Ironton, Ohio.

4.0 Scope and Role of Operable Unit Response Action

The Site is being addressed through three OUs. This ROD is for OU3, the Tar Plant, and represents the final response actions for the Site. The remedial actions for OU1-GDA were documented in the 1988 ROD. The remedial actions for OU2-CPLA were documented in the 1990 ROD and three ROD amendments in 1995, 1997, and 1999. The OU1 and OU2 RODs included: excavation and proper disposal of contaminated soil, use of certain excavated materials as alternative fuels; installation of containment systems (slurry wall, RCRA cap, hydraulic extraction systems); site-wide groundwater extraction and treatment in an on-site waste water treatment plant, and a site-wide groundwater monitoring system. The OU1 and OU2 remedies also allowed for reuse of the properties. On area has been converted into a wetlands (lagoon area) and another area has been converted for use as a State of Ohio Department of Transportation facility.

Currently, due to implementation of the OU1 and OU2 RODs, groundwater contaminant migration is controlled at the GDA, CPLA, and Tar Plant. The pump and treat system has been in place since 1997. Once treated at the on-site wastewater treatment plant, the groundwater is discharged into the Ohio River through National Pollutant Discharge Elimination System (NPDES) permitted outfalls. The pumping wells that comprise the groundwater collection network include four lagoon area wells and two Tar Plant area wells. Evaluation of progress towards achievement of the established Site groundwater cleanup standards is accomplished through quarterly performance of a monitoring program. In addition, Honeywell has implemented a focused remediation effort involving DNAPL recovery via a dedicated pumping system installed in Tar Plant pumping well WE-618.

Since groundwater contamination, including the DNAPLs has been addressed via the OU1 and OU2 work through OU1 and OU2 enforcement documents, groundwater did not need to be addressed through OU3. Therefore, OU3 addresses only contaminated soil, including any vapor and ambient air issues, and sediment.

5.0 Site Characteristics

5.1 Overview of the OU3 Tar Plant

The Ironton Tar Plant is located at 3330 South Third Street in Ironton, in the southwest quarter of section 30, T1N, R18 E, Lawrence County, Ohio (Figure 1). The Tar Plant, along with the CPLA and GDA, comprise the former Allied Chemical/Ironton Coke facility and the Site.

The Tar Plant occupies approximately 27-acres in an industrially zoned section of Ironton. The Tar Plant is bordered to the east by the former CPLA, to the south by Ironton Bulk Terminals Inc., to the west by Norfolk-Southern Railroad tracks, beyond which is the Ohio River, and to the north by the GDA. Except for a 3-acre parcel located within the Ohio River floodplain (between the railroad tracks and the Ohio River), the Tar Plant lies on a relatively flat alluvial terrace above the 100-year flood level of the Ohio River [approximately 547 feet above mean sea level (msl)]. Nearby industries along the Ohio River include steel mills, paper mills, coal processing facilities, coke plants, coal plants, pottery plants, and chemical and tools manufacturers. Industries in the vicinity of the Site include coal loading and processing, oil shipping, chemical manufacturing and storage, and steel manufacturing.

One small office building, an open air shed, above-ground water conveyance lines, two groundwater extraction wells, and several monitoring wells are currently located on the Tar Plant property. The Tar Plant is covered by paved or gravel roads, demolition debris, and vacated railroad beds. The approximate 16-acre main parcel is secured by a 6-foot chain-linked fence. The Site layout is shown in Figure 2.

5.2 Site Ecology

All areas of the Tar Plant have been altered to varying degrees by management practices, whether from operation-related activities within the last 60 years, or from historical urbanization. No historic natural areas are present within the boundaries and no trees are present that are more than 50 years old, except immediately adjacent to the Ohio River. The habitat value of the Tar Plant itself is considered poor due to the lack of native vegetation and human activity. The Tar Plant offers habitat for only the common species of flora and fauna that have adapted to disturbed habitats. Figure 4 presents a map showing different habitats.

5.3 Site Geology

The regional bedrock consists of Pennsylvanian-aged sandstone, shale, siltstone, limestone, and coal. Bedrock in the upland terrain northeast of the Site belongs to the Breathitt and Lee formations of the Middle and Lower Pennsylvanian Age, respectively. There are no major faults in the region of the Site. Geologic cross sections prepared during the RI show alluvial deposits approximately 55 feet thick on the lower terrace between the railroad tracks and the steep bank of the Ohio River (the River Parcel). The alluvial deposits underlying the River Parcel consist of a surficial layer of clay ranging from 15 to 35 feet in thickness. The hydraulic conductivity in this zone is $2E^{-04}$ feet per day (ft/day). The clay is underlain by sand with gravel layer, which includes a cobble zone approximately five feet thick, underlain by bedrock at about 60-feet below ground surface. The cobble zone above the bedrock contains a mix of cobbles, pebbles, gravel, and sand. This cobble zone overlies bedrock throughout the Site except at a few locations where cobbles are fewer and the layer is mainly sand and gravel. Boring logs for all monitoring wells described the sand and sand with gravel deposits as loose and not compacted.

East of the railroad tracks, the main parcel of the Tar Plant is underlain by about 85 feet of alluvial deposits. The alluvial deposits in this area typically consists of 5- to 10-feet of surficial clay, underlain in succession by: a sand with gravel layer (up to 35-feet thick); a sand layer (up to 35-feet thick); and a cobble zone (about 5-feet thick) overlying the bedrock. The sand and cobble layers are typical high-energy alluvial deposits laid down by water (an ancient river) flowing along the bedrock.

The surficial clay does not underlie the entire main parcel of the Tar Plant. The clay is not present beneath the north tank farm and railroad spur tank car loading area. Bedrock beneath the Site is shale and ranges from approximately 55- (river parcel) to 85-feet (main parcel) below ground surface (bgs). The difference is due to the 30-foot elevation change in those areas. The bedrock surface elevations at monitoring wells range from 472-to 482-feet above msl. The southern part of the Main Parcel is in a bedrock low and appears to be separated from another bedrock low in the railroad spur tank car loading area by a bedrock high in the south tank farm area. The northern half of the Tar Plant is also characterized by a generally undulating bedrock surface with highs and lows within a 5-foot range of elevations. A bathymetric survey conducted by the United States Army Corps of Engineers between 1963 and 1965 provides a river-bed elevation of 483-feet above mean sea level (msl) for a profile adjacent to the Tar Plant. The RI data confirmed this information. This feature is a linear bedrock high that appears to separate the Tar Plant from the river channel (483 feet near the shore). Coring of the bedrock and pressurized packer permeability testing conducted for work at the GDA concluded that the bedrock in the area is competent and impermeable.

5.4 Site Hydrogeology

The primary aquifers in this region are the alluvial deposits that lie along the stream and river valleys. The most significant of these are the alluvial deposits associated with the Ohio

River. Alluvial deposits in the smaller stream valleys yield less groundwater than those associated with the Ohio River.

Recharge to the Ohio River alluvial aquifer occurs by: direct infiltration of precipitation; infiltration of runoff from tributaries originating in the uplands; and by groundwater migrating from the uplands. The United States Geological Survey (Ground Water Atlas of the United States, HA730L) estimates that 60 to 70 percent of the alluvial aquifer recharge is from upland runoff onto the river terrace. The Ohio River is the major discharge point for the groundwater, while the tributaries receive smaller amounts of discharge.

Currently, municipal water is available within the City of Ironton, and the City has an ordinance prohibiting the installation of water wells.

The Site lies over 55 to 85 feet of highly permeable alluvial deposits along the Ohio River. Groundwater occurs in the lower 40 feet of the Site alluvial deposits. The thickness difference is the result of the lower grade elevation between the railroad tracks and the river compared to the main parcel.

The saturated zone in monitoring wells between the railroad tracks and the Ohio River is confined locally by the surficial clay layer. The lower 1–foot of clay at the clay-sand interface (at 519 feet above msl) was saturated at the time monitoring well MW-53 was installed. Similar conditions were found at the other monitoring wells near the river. The water table fluctuations caused by river level changes and recharge results in groundwater rising to the bottom of the clay. The aquifer confinement is temporary and incomplete since the condition only occurs along the river. Groundwater in the main parcel is under unconfined water-table conditions.

The water table surface is relatively flat at the Site and in the surrounding area, except near the pumping wells. Generally, the difference between the highest and lowest groundwater elevations is less than 2-feet resulting in low horizontal groundwater gradients. The horizontal hydraulic groundwater gradient prior to start of extraction well system was 0.00023 as measured along 1,250 feet between monitoring wells C-9 and T-11 at the north and south ends respectively, of the Site. The calculated horizontal hydraulic groundwater gradients vary because of the gradient changes around the two pumping wells (WE-618 and WE-1800). The calculated gradient between MW-54D and the Ohio River on May 17, 2006 was 0.0024 along the distance of 480 feet between the two data points.

The water table configuration and low horizontal gradients reflect the highly permeable nature of the aquifer. Hydraulic conductivities were estimated at 100 ft/day. Hydraulic conductivities were calculated at 310 ft/day at the CPLA parking area and 45 ft/day in the lagoon area.

The alluvial aquifer's average permeability is 100 ft/day. The estimated aquifer transmissivity is 4,000 ft^2 /day using 40 feet as the saturated thickness. The permeability of the cobble zone (typically about five feet thick) overlying bedrock may be in the 100 to 500 ft/day range based on its grain size distribution and loose consistency. The cobble zone transmissivity could be as high as 2,500 ft^2 /day.

No additional permeability testing was required during the Phase IA RI because the existing database included an adequate number of permeability determinations from pumping tests, grain size analysis, slug tests, and laboratory testing. The nearby Ohio River bed lies on the bedrock surface and the alluvial aquifer discharges occur primarily along the highly permeable lateral groundwater-surface water interface. As a result, there is little, if any, upward vertical gradient at the Site and groundwater flow is horizontal throughout the saturated thickness. The aquifer water levels respond to river level changes and groundwater flow reversals have been documented along the river shoreline (Monthly Capture Zone Reports to U.S. EPA and Ohio EPA). The shale bedrock is not a significant groundwater migration pathway due to its low permeability and would not be expected to provide any groundwater discharge to the river from the Site.

Figure 4.9 of the Phase Ia RI shows the interpreted groundwater flow directions in the alluvial aquifer at the Site on May 17, 2006. Four pumping groundwater remediation wells at (WE-1800 and WE-617) and near (WE-2405 and WE-2425, off the map to the north) the Site were pumping at the time of the water level measurements. The influence of the pumping wells results in groundwater capture in the main parcel, and to a lesser degree in the river parcel where a groundwater divide is present and groundwater flows to the Ohio River. Groundwater flow is reversed when the river elevation rises above the water level elevations in monitoring wells within about 250 feet of the river. Under these conditions, groundwater near the river is held as bank storage until the river level drops. This occurs when the downstream Greenup Lock and Dam opens and closes. It also occurs when the river rises and falls in response to rainfall and dry periods.

5.5 Sampling Plan

Prior to initiating the investigation work at the Tar Plant, U.S. EPA and Ohio EPA required Honeywell to perform an in-depth analysis of all previous data collected as part of the OU1 and OU2 work, as well as for work conducted as part of the Tar Plant's operating permit. Honeywell's first deliverable to U.S. EPA and Ohio EPA described everything known up to that point in time (1993) on contamination at the Tar Plant and identified the data gaps to fill during the upcoming Tar Plant remedial investigation. A copy of that report is in the Administrative Record.

Subsequent to that work, a sampling strategy was defined for the Tar Plant and is described in the Work Plan, also included in the Administrative Record.

In summary:

- Determine the presence, concentrations, and extent of hazardous substances in soil, sediment, surface water, ambient air and soil gas;
- Identify additional source(s) of hazardous substances to media listed above, if present;
- Refine what is already known about water-bearing strata underlying the Tar Plant, including stratigraphy and hydrogeology and evaluate temporal variations in ground water flow and contaminant concentrations; and

- Evaluate ambient air and soil gas vapors for potential current and future inhalation exposures.

5.6 Conceptual Site Model

The conceptual site model (CSM) is presented in Figure 5 (human health) and in Figure 6 (ecological). These figures describe the primary contaminant sources, the primary release mechanisms, secondary sources, secondary release mechanisms, and migration pathways.

Contaminants have been introduced to soil and sediment at the Tar Plant through historic inadvertent releases of raw and production chemicals and the handling of process waste streams. In addition, some releases occurred at former docking facilities at the river's edge.

Also of potential concern is the possible migration of DNAPL to surface water. DNAPL exists along a band from the west central portion of the Site (where recovery well WE-618 is located) to the southeastern corner near the former South Tank Farm and the former Crude Tar Unloading Area. Depressions in the bedrock surface seem to limit further migration of the pooled DNAPL toward the Ohio River as does the current DNAPL extraction system, a dual-phase well (WE-618). As of June 2007, approximately 5,525 gallons of DNAPL (product) has been recovered. This DNAPL recovery program is part of the OU2 work; an approved off-site fuels blending program. Optimization of the DNAPL extraction and monitoring program is planned via the OU1/OU2 site-wide groundwater program.

The City of Ironton derives its water supply from the Ohio River (approximately two miles downstream of the Site). The City of Coal Grove has a well field located approximately 2,000 feet south (upriver) of the Site, on the south side of Ice Creek. Neither of these water supply sources is at risk from the Site, since the groundwater containment system is in place and has been fully operational for over a decade. The existing monitoring well network serves as a warning mechanism to ensure that the water supply wells are not impacted. The extraction system has been modified over time based on results of the monitoring program, ensuring that the necessary cone of depression is maintained. Extraction wells have required maintenance to improve their performance and additional wells have been installed to address higher than usual water table conditions. In addition, the City of Ironton currently has an ordinance prohibiting the installation of water wells.

Discharges to the river sediments and surface water occurred in the past primarily due to releases at the docking facilities, contaminated run-off from the Site through outfall structures, and possibly through the discharge of contaminated groundwater through riverbed sediments. Currently, the discharge of untreated run-off and the discharge of contaminated groundwater are prevented via the remedial actions implemented under OU1 and OU2.

Under current Site conditions and remedial measures, contaminated groundwater does not discharge into surface water (Ice Creek and Ohio River). Future use of groundwater is unlikely until acceptable criteria are met, and may be subject to administrative controls. The City of Ironton currently has an ordinance prohibiting the installation of wells.

Tar Plant soils may pose a risk through contact or exposure to soil gas scenarios to workers. The Tar Plant presents limited terrestrial habitat, but could pose risk to non-human terrestrial receptors. Sediment adjacent to the Tar Plant presents potential risks to ecological receptors living in, and using, this reach of the Ohio River.

5.7 Nature and Extent of Soil Contamination

This section of the ROD summarizes the nature and extent of soil contamination found at the Tar Plant. Samples were analyzed for volatile organic compounds (VOCs), polyaromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), arsenic, free and total cyanide, total phenols, and ammonia.

VOCs

VOCs in shallow soil:

Concentrations and distributions of benzene, toluene, ethylbenzene, and xylene (BTEX) and styrene in the shallow soils reflect the greater mobility of benzene (volatilization and solubility). Benzene may not have been the predominant compound in the freshly released material; however, the greater proportion of benzene in the groundwater and its chemical/physical properties suggests higher initial benzene in soil. The predominant compound becomes xylene in the shallow soil, although benzene, ethylbenzene, and toluene are still present. Notably, elevated concentrations appear in relatively contiguous areas near the southern extent of the Tar Plant (GP-102 and GP-103), in the eastern portion of the former south tank farm, and in and around the former north tank farm. The maximum total VOCs in one sample were 260 milligrams per kilogram (mg/kg) at GP-103. A few isolated areas with VOC concentrations between 1 and 10 mg/kg were detected, but the remainder of the Tar Plant exhibited relatively low (below 1 mg/kg) residual VOC concentrations in the shallow soil.

VOCs in deep soil:

Concentrations and distributions of BTEX in the deep unsaturated soil also show the pattern of a diminished benzene portion likely due, again, to a higher volatilization and leaching potential for benzene. Total VOCs appear mainly elevated in areas from the former south tank farm to the former north tank farm and at the southern end of the Tar Plant, near MW-37 (maximum of 406 mg/kg at 37 to 39 ft bgs). The VOC distribution pattern in deep soils is similar to the DNAPL distribution appearing to suggest a correlation with DNAPL. VOC concentrations were highest in two areas: one near MW-35D, -51D, and -36 with measured DNAPL thicknesses of 2.5, 3.5 and 1.2 feet respectively; and a second further south near MW-37 which had a measured DNAPL thickness of 3.24 feet. Deep soil samples along the Ohio River were reported as non-detect for target VOCs.

Total PAHs

PAHs in shallow soil:

Approximately 60 percent of the southern and central portions of the main parcel had shallow soil total PAH concentrations in excess of 7,000 mg/kg, and about 80 percent of the area had concentrations greater than 700 mg/kg. A maximum concentration of 44,100 mg/kg was reported in a sample at MW-55S. A portion (about 1.5 acres) of this area above 7,000 mg/kg extends across and west of the railroad tracks at DPS-79, GP-095 and GP-096 onto the river parcel. About one-third of the main parcel exhibited shallow soil concentrations less than 700 mg/kg. Naphthalene was present in about 40 percent of the samples through the former tank farm areas, but was less frequently (about 12 percent) a significant component of the total PAH elsewhere.

PAHs in deep soil:

The southern portion of the Tar Plant, covering most of the former south tank farm and extending northwest to the former north tank farm and south to MW-37 indicated total PAH concentrations in excess of 7,000 mg/kg. Lower concentrations were observed to the north. About 12 percent of the main parcel had deep soil PAH concentrations in excess of 1,000 mg/kg and about 20 percent had concentrations in excess of 100 mg/kg. Locations of elevated concentrations of PAHs in deeper soils are correlated to observed DNAPL saturated soils. Naphthalene was present in a slightly greater proportion of the deeper samples than in the shallow soils. Concentrations of carcinogenic PAHs (cPAHs) were typically less than, or much less than, the other PAHs. Concentrations of total PAHs along the river were typically less than 7 mg/kg.

Arsenic

Arsenic in shallow soil:

Arsenic was not detected in high concentrations in shallow soil. In about 130 total samples, arsenic exceeded 10 mg/kg in only 15 samples. The maximum concentration reported was 18.7 mg/kg at MW-38 and also about the same at 18.6 mg/kg at DPS-03 and at DPS-63. Except for a grouping of the higher concentrations along the west side of the railroad and at the elevated pipeline, the remaining concentrations above 10 mg/kg were relatively evenly distributed between the southern and northern portions of the Tar Plant.

Arsenic in deep soil:

Arsenic was detected in deeper soils at slightly lower concentrations than in shallow soil. In about 100 total samples, arsenic exceeded 10 mg/kg only once (14.4 mg/kg at OU3-TPB-05 at 19 to 21 ft bgs). Most concentrations reported were less than 5 mg/kg.

Total Phenols

Total phenols in shallow soil:

In about 130 shallow soil samples, total phenols equaled or exceeded 10 mg/kg in about 11 samples. Three of these (including one duplicate) came from the same location. Six locations of these elevated sample results were in the southeastern corner of the Tar Plant, while two of the remaining elevated results were from the central portion of the Tar Plant, and the last at the north end of the Tar Plant. The maximum concentration was 280 mg/kg (DPS-24) while the concentrations of the next highest samples fell off rapidly.

Total phenols in deep soil:

In about 100 deep soil samples, total phenols exceeded 10 mg/kg in only nine instances. This included one duplicate and three samples at varying depths at the MW-37D location. In addition, the two highest concentrations reported, 220 mg/kg (150 mg/kg duplicate) and 150 mg/kg, were recorded at the 5 to 7 foot intervals at MW-36S and TPB-01, respectively. These higher concentration samples were, again, located at the former south and north tank farm areas, and at the southern end of the Site at MW-37. The three samples at the MW-37D location indicated 18 mg/kg at 17 to 19 feet, 130 mg/kg at 37 to 39 feet, and 78 mg/kg at 39 to 41 feet bgs.

Ammonia

Ammonia in shallow soil:

In about 130 shallow soil samples, ammonia (as N) equaled or exceeded 10 mg/kg in 12 samples. Most of these higher elevated concentrations were located in the former south and north tank farm areas. The maximum ammonia (as N) concentration was 70 mg/kg at DPS-26 in the southeast corner of the Tar Plant.

Ammonia in deep soil:

In about 100 deep soil samples, ammonia (as N) equaled or exceeded 10 mg/kg in five samples (including one duplicate). All samples with elevated concentrations were located within or next to the former south tank farm. The maximum ammonia (as N) concentration was 30 mg/kg in the duplicate for MW-36S. The sample at MW-36S, however, was still relatively shallow at 5 to 7 ft bgs.

PCBs

A total of 17 composite and 18 non-composite surficial soil (0 to 0.5-foot) samples were collected during the Phase Ia RI for PCB analysis. PCBs were reported as Aroclors. Only Aroclors 1248 and 1260 were found.

The 17 composite samples were collected as a screening measure in areas that were considered to have little potential for significant PCB contamination. While PCBs were found in all composite samples, concentrations were typically low. Aroclor 1248 concentrations ranged from non-detect to 180 micrograms per kilogram (µg/kg) and Aroclor 1260 concentrations ranged from 12 to 1200 µg/kg. The range of total PCBs in these samples was also from 12 to 1200 µg/kg (SSCOM04). The next higher sample contained 760 µg/kg. Only five of the 17 composite samples had total PCB concentrations above 100 µg/kg.

Fifteen discrete samples were obtained primarily in the former anthracene production area and transformer warehouse, along the northern extent of the former north tank farm. Three discrete hand-auger soil samples (HA-4 through HA-6) were located in the vicinity of Outfall 001 to evaluate PCB concentrations near the Ohio River, as PCB was reported in detectable levels in a composite soil sample (SSCOM12-2) previously obtained from this location by compositing three discrete soil samples (HA-1, HA-2, and HA-3). Either or both Aroclor 1248 and 1260 were reported in 17 of the 18 samples; only the sample at DPS-68 was non-detect. The maximum concentration of either was 6,500 µg/kg Aroclor 1260 in DPS-78. The maximum total concentration was 7,700 µg/kg at DPS-75. The three hand auger samples near Outfall 001 ranged from 45 to 191 µg/kg total PCBs. Five of the samples had total PCB concentrations less than 100 µg/kg.

5.8 Nature and Extent of Ambient Air and Soil Vapor Contamination

During the Phase Ia RI twelve paired locations of soil vapor and ambient air were analyzed for VOCs and naphthalene.

Soil Vapor:

Soil vapor samples were obtained at 11 of the 12 locations at a depth of 4.5 to 5.0 feet bgs. The remaining sample (SV-27) was obtained from 2.5 to 3.0 feet bgs. Results for each are discussed below. Analysis of samples indicated only BTEX, styrene, and naphthalene present in the soil vapor samples. Benzene and toluene were the largest percentage of most samples, while other VOCs were smaller contributors. Two samples had total VOC concentrations of 1 to 10 parts per billion by volume (ppbv); five were in the 10 to 100 ppbv range; two in the 100 to 1000 ppbv range; two in the 1000 to 20,000 ppbv range; and one (the maximum) had 81,090 ppbv. Maximum individual compound concentrations detected were: benzene (55,000 ppbv); toluene (20,000 ppbv); ethylbenzene (1,500 ppbv); xylenes (4,080 ppbv); styrene (510 ppbv); and naphthalene (1.6 ppbv, although there is a 500U ppbv non-detect reported for SV-24). The highest concentrations for nearly all compounds detected came from one sample; SV-24. Although all soil vapor samples contained site-related VOCs, the three highest soil vapor concentrations were in samples from the former south and north tank farm areas.

Ambient Air: Analysis of the corresponding location ambient air samples revealed only toluene (detected in all twelve samples), benzene (detected in two samples), and naphthalene (detected in only one sample). The maximum concentrations of compounds were: benzene (0.31 ppbv); toluene (0.98 ppbv); and naphthalene (2 ppbv).

5.9 Nature and Extent of Surface Water Contamination

Both 2004 Phase 1 and 2006 Phase Ia surface water data are presented and discussed here. Each is discussed separately and then the two are compared. In 2004, samples consisted of five transects along the Ohio River adjacent to the Site and at two transects upriver. Transects consisted of three samples each, approximately at the shore and at 100 and 150 feet perpendicular to the river bank. 2006 sample locations were interspersed with the 2004 locations, with a total of 17 samples (plus one duplicate), four of which were at upriver locations (upstream south of the mouth of Ice Creek). The upstream samples together with their associated sediment samples, although showing some impact from other upriver sources, form an effective upgradient or background data set for comparison with samples adjacent to the Site in risk assessment. Data are presented in Tables 5.5A (2004 data) and 5.5B (2006 data).

2004 Sample Results:

Surface water sample results for VOCs were nearly all non-detect except for analytes known to be common laboratory influences (e.g., acetone, chloroform and methylene chloride), and these detections were all flagged BJ (B - present in blanks and J - estimated) or B. An exception was tetrachloroethene in one sample detected at 0.17 micrograms per liter (µg/l). Tetrachloroethene is not believed to be related to the Tar Plant. It is not discussed further as it was not detected in other media at the Tar Plant, nor does it appear to have been used in processes at the Tar Plant.

Six upstream samples were non-detect for PAHs except for three samples with fluoranthene at 0.39, 0.42, and 0.49 μg/l. Dissolved and total arsenic were reported as non-detect, but had an elevated detection limit of 10 μg/l. Cyanide was non-detect except for 5.8B free cyanide and 3.3 μg/l total cyanide in one sample. Total phenol concentrations were low when detected, ranging from 0.014B to 0.082 J micrograms per liter (mg/l). Ammonia (as N) was reported as 0.84BJ to 1.4BJ mg/l, i.e., all with blank and estimated flags.

Fifteen samples and two duplicates were taken on transects adjacent the Site. These samples were non-detect for total PAHs in 14 cases; fluoranthene was detected at 0.39 and 0.44 μg/l in two other samples. Sample SW-10 was reported as having 5.59 μg/l total PAHs, but this appears to be anomalous and may indicate the presence of suspended sediment in the sample. SW-10 is near the outlet of Outfall 001 where the highest total PAHs were detected in sediments. Both dissolved and total arsenic was reported as non-detect, but the detection limit was elevated (10 μg/l) relative to the 2006 concentrations. All free and total cyanide results were non-detect relative to a 10 μg/l detection limit. Ammonia was reported at 2J and 4.5J mg/l, with 15 of 17 sample results flagged BJ. Total phenols were non-detect in 12 of 17 samples; the remaining results were reported as 0.012BJ to 0.018BJ mg/l.

2006 Sample Results:

Surface water samples were non-detect for VOCs and for free and total cyanide. Detections are summarized here for total PAHs, arsenic, phenols, and nitrate (as N).

Upstream samples for total PAHs ranged from non-detect to 0.236J μg/l; all detections were flagged J as estimated. Arsenic was detected in one unfiltered sample at 3.1 J μg/l, and all filtered samples were reported as non-detect. Total phenols were also non-detect. Nitrate was detected in a narrow range of 0.67 to 0.77 mg/l as N.

In surface water samples bordering the Site, total PAHs ranged from 0.04J (SW-36) to 6.06J μg/l (SW-38). The SW-36 sample results appear anomalous as the next highest result was 0.75J μg/l, and may indicate the presence of suspended solids in sample SW-38. Many samples fell in the 0.5 to 0.8 μg/l range. The results for dissolved arsenic ranged from non-detect to 0.61J μg/l; those for total arsenic ranged from non-detect to 2.3J μg/l. Total phenols ranged from non-detect to 0.044 J mg/l. Nitrate as N was reported in a narrow range of 0.66 to 0.72 mg/l.

5.10 Nature and Extent of Sediment Contamination

In 2004, an attempt was made to collect sediment samples collocated with each of the 21 surface water sample locations, but only 13 samples (plus one duplicate) could be collected. Likewise, in 2006 only 13 samples (plus one duplicate) from the 17 locations attempted could be collected. This is because fine-grained sediments were absent, or too thin to provide samples. Many locations were "hardpan" or cobbles. Sediment data are presented on Tables 5.6A (2004 data) and 5.6B (2006 data). Samples were analyzed for VOCs, SVOCs, arsenic, ammonia (2004 only), nitrate (2006 only), total phenols, cyanide, and PCBs (2006 only).

2004 Sample Results:

Five upstream samples (south and upstream of the conjunction with Ice Creek) and eight locations (plus one duplicate sample) adjacent to the Site were collected. The results for each analyte or analyte group are discussed in the following paragraphs.

The only site-related target VOC detected in upstream sediment samples was toluene at 1 μg/kg in two samples. Several non-target VOCs were detected, including 2-butanone, carbon disulfide, cyclohexane, and methyl acetate. These other VOCs were reported in relatively low concentrations and most were flagged J (estimated). Total PAHs detected ranged from 21 to 2,545 μg/kg, and were present in all samples. Arsenic varied from 4.8 to 12.3 mg/kg. Cyanide was not detected. Ammonia (as N) varied from non-detect to 2.1 mg/kg. Total phenol results indicated both presence in blanks as well as possible matrix interference (flagged G) in three samples, the highest reported as 4.4 mg/kg; the other two samples were reported as 1.5 and 1.8 mg/kg.

In samples adjacent to the Site, benzene was present in two samples with a maximum of 8 μg/kg (3J in the duplicate); ethylbenzene was present in one sample at 2J μg/kg; toluene in four samples with a maximum of 6J (1J in duplicate); and xylene in two samples at a maximum of 1J ppb. Concentrations of total PAHs ranged from 492 to 104,280 parts per billion (ppb), with the highest concentrations found just downstream of Outlet 001. The greatest concentration was found near the shoreline. Arsenic was found to vary from 4.3 to 11.7 mg/kg. Cyanide (free) was not detected. Samples for ammonia were mainly non-detect except for two samples reported as 0.07B and 0.08B (present in blanks). Total phenols were all flagged "BJ" with a maximum reported value of 1BJ mg/kg.

<u>2006 Sample Results</u>:

Two upstream sediment samples (south and upstream of the conjunction with Ice Creek) and 11 locations were sampled along the river at the Site (plus one duplicate sample) interspersed with the 2004 sample locations. The results for each analyte or analyte group are discussed in the following paragraphs.

No VOCs were detected in the upriver sediment samples. Total PAHs were 6,952 and 4,110 μg/kg in these samples. Arsenic was detected at 4.8 and 5.5 mg/kg in the two samples. Nitrate was non-detect. Total phenols were 0.33J and 1.4J mg/kg.

In samples obtained adjacent to the Site, VOCs were detected in only two samples. Sample SD-34 had benzene at just 0.8 μg/kg, while SD-33 displayed significant residual BTEX that may be bound up in the sediment matrix. This sample also displayed the maximum PAH. Benzene was present in SD-33 at 170 μg/kg, ethylbenzene at 58 μg/kg, toluene at 46 μg/kg, and xylenes at 110 μg/kg. Styrene was also detected in this sample at 45 μg/kg. PAHs were present in all samples; however concentrations were particularly elevated in three samples. SD-31 had 184,100 μg/kg (69,470 μg/kg duplicate); SD-33 had 1,053,100 μg/kg; and SD-34 had 222,650 μg/kg. Highest concentrations were again present in samples downriver of Outfall 001. Samples upstream from the outfall and at the most northern (downstream) sample locations had total PAHs less than 10,000 μg/kg. Arsenic concentrations ranged from 3 to 6.4 mg/kg. Nitrate was non-detect in six samples and ranged up to 63 mg/kg when detected. Total phenols ranged from 0.24 to 1.7 mg/kg. PCBs were detected at two of the sample locations, at relatively low concentrations. SD-33 (the most contaminated sample) had 140 μg/kg of Aroclor 1248. Sample SD-34 (the second most contaminated sample) had 38 μg/kg of Aroclor 1248 and 19 μg/kg of Aroclor 1260.

5.11 Potential Routes of Contaminant Migration

Natural primary pathways of contaminant migration have included:

- Historic releases to soils with subsequent leaching or percolation to groundwater.
- Past migration of contaminated groundwater to the Ohio River.
- Transfer of VOCs from soil and groundwater to air (soil gas and/or atmospheric air).
- Releases of constituents directly to surface water and sediments due to accidents at the docking facility.
- Run-off of precipitation in contact with contaminated soils or surfaces directed to surface water (may include contaminated soil particles).

- Release of contaminants in sediments (secondary source) to surface water.
- Transport of surficial soil contaminants strongly sorbed to particulates (e.g., PAHs and PCBs) by water or wind erosion.
- Spread of DNAPL laterally over impermeable surfaces (e.g., bedrock or low permeable lenses in saturated or unsaturated zones).

5.11.1 Fate and Transport in Soils

Historic releases to soils included solvents, oils, and process and waste chemicals, and sludges. These releases also included DNAPL. Percolation of DNAPL into the ground resulted in transfer of some portion of the constituents to surficial and sub-surface soils through sorption or capillary processes. DNAPLs also percolated to deeper soils below the water table, leaving behind ganglia of product in both saturated and unsaturated zones. DNAPLs have accumulated at the bedrock surface. There is a potential for limited further lateral migration of DNAPL based on the topography of the bedrock surface, presence of more permeable gravelly zones above the bedrock, and induced gradients toward extraction wells. A "bedrock high" appears to separate the Site from the river channel, and may be acting to prevent migration of DNAPL into the Ohio River. The DNAPL extraction system currently in place (OU2) also serves to prevent migration of the DNAPL. Subsequent precipitation percolating or groundwater seepage through these areas could solubilize or desorb these residual constituents in soils resulting in a prolonged release to groundwater. Compounds such as the PAHs and PCBs would tend to stay sorbed to soils, although naphthalene may demonstrate some appreciable degree of leaching and degradation. These compounds would be considered to be persistent in the soils.

Contaminants in surficial soils may volatilize, be leached, be subject to erosion by water or wind (especially contaminants with high partition coefficients that may sorb strongly to particulates), or be conveyed by traffic where vehicles may contact contaminated soils. These mechanisms may result in the spread of contaminants. Under current conditions, traffic and water erosion are likely not significant.

Sorption of Site-related constituents to soils below the groundwater table also occurs, and leads to retardation of plume migration in groundwater.

5.11.2 Fate and Transport in Groundwater

Groundwater is not a media of concern for the OU3 ROD as the migration of contaminated groundwater is currently prevented through the OU1 and OU2 remedies, which have been in operation for over a decade.

5.11.3 Fate and Transport in Surface Water

VOCs present in surface water would tend to volatilize to the atmosphere. Rates of loss from the surface water depend on temperature, turbulence, and the depth of the water. Exposure to sunlight may also provide an opportunity for photolytic decomposition of

PAHs. Surface water can also serve to redistribute contaminants found in sediment through a process of scour and deposition.

5.11.4 Fate and Transport in Sediments

Sediments can serve as a residual source of contaminants to surface water either by retaining them via direct release or through accumulation from groundwater as the partition coefficients are typically greater for sediments than aquifer materials. However, sediments may also serve as an active site for biodegradation of some of these compounds due to the increase in biological activity and higher carbon sources which lead to greater sorption potentials. The interaction of sediments and surface water may physically alter and decrease sediment contaminant concentrations.

5.11.5 Fate and Transport in Air

The presence of volatile compounds in air was evaluated with samples of atmospheric air as well as soil vapor. Surficial soils do not contain sufficiently high concentrations of volatile compounds to significantly affect concentrations in atmospheric air. However, soil vapor, the air in the interstitial pore space of unsaturated soil impacted by volatile compounds, can exhibit higher concentrations of volatile compounds (principally BTEX and possibly naphthalene). Due to the presence of these compounds in soils or shallow groundwater, the compound attempts to equilibrate between soil moisture, soil and air phases. Migration may occur due to advection of soil vapor or by diffusion. Migration may also include seepage up and into buildings above such soil gas, or may result in discharge to the atmosphere. Discharge of soil vapor to atmospheric air is quickly diluted by air movement and no significant concentrations of Site compounds were found in atmospheric air samples. Some further degradation of compounds in air is possible by photochemical processes.

Wind erosion of contaminants strongly sorbed to fine surficial soil particles (e.g., PAHs and PCBs) is also possible. Depending on soil particulate size, cover and wind conditions, some transport may occur. As the finer particles are depleted, potential transport by wind erosion typically becomes less over time. Remedial measures, including engineered controls, also may be employed or exist to reduce migration potentials.

Water erosion of contaminated fine surficial soil particles is also possible, but typically requires uncontrolled drainage of storm waters to transport significant quantities of contamination to the environment.

5.12 Current and Potential Future Routes of Human and Ecological Receptor Exposure

The exposure pathways identified for the Tar Plant are exposure to surface and sub-surface soils on the main and river parcels, and exposure to surface water and sediments in the Ohio River. Also of concern is the potential for exposure in the future of indoor workers to vapor intrusion if any buildings are built on-site or to future construction workers performing on-site excavations.

Ecological receptors are potentially exposed to contaminated surface soils through direct contact and incidental ingestion during grooming and feeding. Exposure to sediments and surface water occurs through direct contact. Upper trophic level receptors are exposed to contaminants through these pathways and by consuming contaminated prey.

6.0 Current and Potential Future Site and Resource Uses

The area surrounding the Tar Plant is mixed industrial and commercial. However, there are also some nearby residential areas. All buildings on the Tar Plant, except for one, have been razed. The Tar Plant property is currently vacant, unused and owned by Honeywell. The City of Ironton is interested in exploring the use of the Tar Plant property for future recreational, commercial, or industrial purposes.

7.0 Summary of Site Risks

This section of the ROD provides a summary of the Tar Plant's human health and environmental risks. A Baseline Human Health Risk Assessment (HHRA) and a Screening Ecological Risk Assessment (SERA) were performed during both the Phase 1 and Phase Ia RIs, completed in June 2005 and April 2007 respectively. The HHRA and the SERA estimated the probability and magnitude of potential adverse human health and environmental effects from exposure to contaminants associated with the Tar Plant assuming no remedial action was taken. The HHRA and the SERA provide the basis for taking action and identify the contaminants and exposure pathways that need to be addressed by remedial actions.

7.1 Summary of Human Health Risk Assessment

The baseline human health risk assessment (HHRA) followed a four-step process:

a. Hazard identification [identification of chemicals of concern (COCs)]

b. Exposure assessment

c. Toxicity assessment

d. Risk characterization

The HHRA used an exposure point concentration (EPC) for each COC and the reasonable maximum exposure (RME) scenario to estimate risk. The RME scenario is the maximum exposure that is reasonably expected to occur at the Site.

Tables 1 - 5 present the COCs and exposure point concentrations (EPCs) for each COC in soil, surface water, sediment, ambient air and soil vapor respectively.

7.1.1 Identification of COCs

COCs are chemicals that pose an excess lifetime carcinogenic risk to human health greater than 1 in 1,000,000 (1 X 10^{-6}), or have a noncarcinogenic hazard index (HI) greater than (>) 1.

A concentration-toxicity screening was used to reduce the number of chemicals evaluated in the HHRA to only those that would potentially pose more than a de minimis health risk.

The results of the COC selection are discussed below, by medium.

- Surface soil – river parcel: COCs include benzene; all PAHs analyzed for except 1-methylnaphthalene, acenaphthylene, and anthracene; Aroclor-1248; arsenic; and ammonia.
- Subsurface soil – river parcel: Only three analytes were retained as COC: one PAH (benzo (a) pyrene); arsenic; and ammonia.
- Surface soil – main parcel: COCs include benzene; xylene; all PAHs analyzed for; total phenols; Aroclor-1248, Aroclor-1260; arsenic; and ammonia.
- Subsurface soil – main parcel: COCs include benzene; xylene; all PAHs analyzed for except acenaphthylene and anthracene; arsenic; and ammonia.
- Surface water: COCs include tetrachloroethene; four PAHs; and arsenic.
- Sediment: COCs include eight PAHs; Aroclor-1248; arsenic; and ammonia.
- Ambient air: COCs are limited to benzene and naphthalene.
- Soil vapor: COCs include benzene; ethylbenzene; toluene; xylene; styrene; and naphthalene.

In soil and sediment, ammonia was retained as a COC because no screening value is available. All other chemicals were retained as COCs because they were detected at maximum concentrations in excess of the preliminary remediation goal (PRG) and/or applicable or relevant and appropriate (ARAR) values.

Data Quality

The data used in the HHRA were collected in accordance with U.S. EPA methods and associated QA/QC procedures as described in the quality assurance project plan (QAPP). The data were of suitable quality for use in the risk assessment. Sample quantitation limits for VOCs, PAHs, and aroclor-1248 in soil, benzene and naphthalene in ambient air, and benzene, naphthalene, and m,p-xylene in soil vapor, were above risk-based screening values in some samples. This indicates that quantitation limits for the affected samples were not low enough to determine if the constituent was present in the sample at a concentration that could be associated with a potentially significant health risk. Implications of elevated quantitation limits on the results of the HHRA are evaluated in the risk characterization uncertainty analysis.

7.1.2 Exposure Assessment

The objectives of the exposure assessment are to evaluate potential current and future human exposures to COCs in all media of concern. Receptors (adult/child) were identified for both current and potential future site conditions. The conceptual site models (CSMs) (Figures 5 and 6) show the potential exposure pathways and the receptors at the Tar Plant and were developed based on local land and water use associated with the Tar Plant. Table 6 presents the receptors and pathways evaluated in the risk assessment.

The exposure media and potentially complete exposure pathways to those media include:

- Surface Soil: direct contact (incidental ingestion, dermal contact), dust inhalation, inhalation of vapors that may off-gas from the soil into the air;
- Subsurface soil: direct contact, dust inhalation, inhalation of vapors that may off-gas from the soil, inhalation of vapors that may migrate from soil to air within future buildings;
- Surface water: incidental ingestion and dermal contact
- Sediment: dermal contact

7.1.3 Toxicity Assessment

Toxicity assessment is accomplished in two steps: hazard identification and dose-response assessment. Hazard identification is the process of determining whether exposure to a chemical is associated with a particular adverse health effect and involves characterizing the nature and strength of the evidence of causation. The dose-response assessment is the process of predicting a relationship between the dose received and the incidence of adverse health effects in the exposed population. From this quantitative dose-response relationship, toxicity values are derived that can be used to estimate the potential for adverse effects as a function of potential human exposure to the chemical.

Two general groups, carcinogens and noncarcinogens, categorize chemicals depending on the types of effects on human health. Exposure to any substance in high enough doses can result in toxic effects. Therefore, many carcinogens also produce known noncancer health effects. Noncancer toxicity values (reference dose [RfD] and reference concentration [RfC]) were used to evaluate the COCs present at the site in environmental media to determine the noncancer toxic effects. Cancer slope factor (SF) was used to evaluate carcinogenic effects. Tables 7 - 10 show the noncancer and cancer toxicity data for the COCs through oral, dermal, and inhalation routes. The toxicity data were evaluated based on information from Agency for Toxic Substances and Disease Registry (ATSDR), U.S. EPA's Integrated Risk Information System (IRIS) database, and National Center for Environmental Assessment (NCEA) issue papers.

7.1.4 Risk Characterization

The risk characterization section of the ROD summarizes and combines outputs of the exposure and toxicity assessments to characterize baseline risk at the site. Baseline risks are those risks and hazards that the site poses if no action were taken.

Risks for each receptor scenario are summarized in Tables 11 through 16. Cumulative receptor risks associated with possible exposures to multiple exposure media (e.g., vapor and soil) are also provided. The risk characterization results are reported according to land use: Current Land Use (Table 11); Future Recreational Land Use (Table 12); and Future Commercial/Industrial Land Use (Table 13). Risk characterization results for the Future Construction Worker scenario are provided in Table 14. Risk characterization results for recreational and commercial/industrial land use exposures to subsurface soil are provided in Tables 15 and 16, respectively.

7.1.4.1 Carcinogenic Risk

For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Excess lifetime cancer risk (ELCR) are probabilities that are expressed in scientific notation (e.g., 1×10^{-6}). An ELCR of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure (RME) estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposure. This is referred to as an ELCR because it would be in addition to the risks of cancer individuals face from other non-site-related causes such as smoking or exposure to too much sun. U.S. EPA's generally acceptable risk range for site-related exposures is 1.0×10^{-4} to 1.0×10^{-6}, or a 1 in 10,000 to 1 in 1,000,000 chance, respectively, of an individual developing cancer in his/her lifetime.

7.1.4.2 Noncarcinogenic Risk

For noncarcinogens (systemic toxicants), potential effects are evaluated by comparing an exposure level over a specified time period (e.g., exposure duration) with a RfD derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any harmful effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ of less than 1 indicates that a receptor's dose of a single contaminant is less than the RfD, and that toxic noncarcinogenic effects from that chemical are unlikely. The HI is generated by adding the HQs for all COCs that affect the same target organ (e.g., liver) or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI of less than 1 indicates that, based on the sum of all HQs from different contaminants and exposure routes, toxic noncarcinogenic effects from all contaminants are unlikely. An HI greater than 1 indicates that site-related exposures may present a risk to human health.

7.1.5 Human Health Risk Assessment (HHRA) Summary

The HHRA evaluated health risks associated with potential exposures to surface soil, subsurface soil, groundwater, air, and surface water and sediment in reach of the Ohio River adjacent to the Tar Plant, for current and potential future open space/recreational and commercial/industrial land uses. The results of these analyses are presented in Tables 11 – 16.

For current land use, the results of the risk characterization indicate that non-cancer risks for potential exposures by a trespasser who is assumed to be exposed to soil at the river parcel and ambient vapors are below the NCP and Ohio EPA risk management threshold limits of a HI of 1. Cancer risks for this scenario are greater than 1×10^{-4} due to direct contact with PAHs in soil, and therefore exceed the upper bound of the NCP risk range and the Ohio EPA cancer risk limit.

For future open space/recreational land use, the results of the risk characterization indicate that non-cancer risks for children and adults who may use the Tar Plant for passive recreational activities and be exposed to surface soil at the main parcel and river parcel, vapors in ambient air, and surface water and sediment in the Ohio River, do not exceed the NCP and Ohio EPA risk management threshold limits of an HI of 1. Cancer risks associated with direct contact exposures to PAHs in surface soil at the main parcel and river parcel are greater than $1x10^{-4}$ due to direct contact with PAHs in soil, and therefore exceed the upper bound of the NCP risk range and the Ohio EPA cancer risk limit. In addition, cancer risks associated with surface water exceed the Ohio EPA cancer risk limit of $1x10^{-5}$ due to PAHs. It is likely that the PAHs in surface water are present as a result of entrained sediment particles in the water and, therefore, are not truly representative of surface water quality or of the fraction that is bioavailable for dermal exposures (which account for all surface water cancer risks in excess of $1x10^{-6}$). If the dermal exposure pathway to PAHs in surface water was considered to be incomplete (due to the presence of PAHs in surface water being an artifact of suspended solids), the surface water risks would decrease to $2x10^{-7}$ and the combined cancer risk for surface water and sediment in the Ohio River would equal the Ohio EPA cancer risk limit.

To evaluate future commercial/industrial use of the Tar Plant, the risk characterization evaluated an indoor worker and an outdoor worker. The results of the risk characterization indicate that non-cancer risks to both indoor and outdoor workers who may be exposed to surface soil, vapors in ambient air and/or vapors in indoor air, do not exceed the NCP and Ohio EPA risk management threshold limits of a HI of 1. Cancer risks associated with direct contact exposures to PAHs in surface soil at the main parcel and river parcel are greater than $1x10^{-4}$ for both the indoor and outdoor worker scenarios due to direct contact with PAHs in soil, and therefore exceed by the upper bound of the NCP risk range and the Ohio EPA cancer risk limit. In addition, cancer risks associated with indoor air exceed the Ohio EPA cancer risk limit of $1x10^{-5}$ due to benzene. Potential exposures to outdoor ambient air are associated with cancer and non-cancer risks well below risk management criteria.

The risk characterization results for construction workers who are assumed to be exposed to surface soil, subsurface soil, and vapors in ambient air during Tar Plant re-development activities indicate that cancer risks for surface soil and subsurface soil at the main parcel, surface soil at the river parcel, and vapors in ambient air exceed NCP and Ohio EPA cancer risk limits. In addition, non-cancer risks associated with inhalation of vapors in ambient air exceed the NCP and Ohio EPA risk management threshold limits of a HI of 1. The principal contributors to cancer risks associated with soil direct contact are PAHs. The principal contributors to cancer and non-cancer risks associated with inhalation of vapors in ambient air are benzene, toluene, and naphthalene.

In addition, to aid in risk management and remedial decision-making, potential exposures to subsurface soil were characterized for both the recreational and commercial/industrial land uses. The results of this assessment indicate that subsurface soil at the river parcel is associated with cancer and non-cancer risks below Ohio EPA risk limits and within or below the NCP risk management criteria. In contrast, cancer and non-cancer risks associated with potential exposures to main parcel subsurface soil are higher than risks associated with potential exposures to main parcel surface soil, and exceed both Ohio EPA and NCP risk management criteria due to PAHs.

In conclusion, the results of the HHRA indicate that:

- Direct contact with surface and subsurface soil at the main parcel, and surface soil at the river parcel, is associated with cancer risks that exceed applicable NCP and Ohio EPA risk management criteria. Inhalation exposures to air within commercial/industrial buildings that may be constructed at the Tar Plant in the future are associated with cancer risks of $2x10^{-5}$, which are within the U.S. EPA acceptable risk range but in excess of the Ohio EPA cancer risk limit and therefore also in excess of the U.S. EPA point of departure for establishing remedial action objectives of $1x10^{-6}$, due to benzene.
- Potential exposures to vapors in air by construction workers during active excavation and grading of the Tar Plant in support of re-development are associated with cancer and non-cancer risks in excess of NCP and Ohio EPA risk management criteria due to benzene, toluene, and naphthalene. The approach used to evaluate potential vapor inhalation risk is conservative; however, risks to construction workers would still be in excess of risk management criteria due to direct contact with PAHs in soil.
- Potential exposures to dust and ambient vapors that may be released from the Site under the current conditions do not pose risks in excess of NCP and Ohio EPA risk management criteria.
- Risks associated with sediment and surface water in the reach of the Ohio River adjacent to the Tar Plant, under the assumption that children and adults use the river for swimming in the future, are associated with cancer risks in excess of Ohio EPA risk management criteria due to PAHs in surface water. However, it appears that the presence of PAHs in surface water is an artifact of sediment entrained in the water, and not dissolved PAHs in the water; dermal exposure to water, which accounted for all risks in excess of risk management criteria, is only applicable to dissolved PAHs. If the PAH detections in surface water are discounted as artifacts of entrained sediment particles, risks associated with surface water would be below the lower bound of the U.S. EPA cancer risk range and combined risks for surface water and sediment would be equal to the Ohio EPA cancer limit.

7.2 Summary of Ecological Risk Assessment

A Screening level ecological risk assessment (SERA) was performed as part of both the Phase I and Phase IA RI. The SERA contributes to the overall characterization of the Tar Plant and serves as part of the baseline used to develop, evaluate, and select appropriate remedial alternatives. The primary objective of the SERA is to evaluate whether unacceptable hazards are or may be posed to ecological receptors as a result of hazardous substance releases. This objective is met by characterizing the ecological plant and animal communities in the vicinity of the Tar Plant, defining the particular chemicals affecting the environmental media at the Tar Plant, identifying pathways for receptor exposure, estimating the potential for hazards to ecological receptors, and determining the extent to which response actions may be warranted. Ecological risks associated with Tar Plant surface soil, surface water, and sediment were characterized consistent with the eight-step approach presented in the *Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments (Process Document).*

The remainder of this section is formatted as follows:

- Screening-level problem formulation;
- Screening-level exposure assessment;
- Screening-level effects assessment;
- Screening-level risk characterization; and
- Summary and conclusions of the SERA.

7.2.1 Screening-Level Problem Formulation

Problem formulation is the initial step of the ERA process where the purpose and scope of the assessment are defined. The problem formulation includes the following components:

- identification of ecological habitats and receptors;
- development of a conceptual site model for receptors, media, and pathways;
- data evaluation and identification of COCs; and
- selection of assessment and measurement endpoints.

Habitats and receptors

Section 7.2 of this ROD presents a discussion of the ecology of the area in the vicinity of and on the Tar Plant. Figure 4 is a map of the habitats found on the Tar Plant. All areas have been altered to varying degrees by management practices, whether from operation-related activities within the last 60 years, or from historical urbanization. No historic natural areas are present within the boundaries and no trees are present that are more than 50 years old, except immediately adjacent to the Ohio River. The habitat value of the Tar Plant itself is considered poor due to the lack of native vegetation and the human activity. The Tar Plant offers habitat for only the common species of flora and fauna that have adapted to disturbed habitats.

Ecological Conceptual Site Model

Two CSMs that identify the sources and migration pathways for Tar Plant -related chemicals, and media where Tar Plant-related chemicals have come to be located, are presented in Section 5.6 of this document. As previously discussed, operations at the former facility resulted in release of tar and tar manufacturing related materials to the soil (primarily surface releases).

Analytical data for soil samples collected at the Tar Plant indicate that PAHs, BTEX, styrene, arsenic, cyanide, and PCBs are present in soil. The majority of soil contamination is associated with the main parcel. The data also suggests that contamination of the River Parcel has occurred, but to a lesser degree. Sediment data in the portion of the river adjacent to the Tar Plant show that an area of sediment exists with elevated concentrations of PAHs. BTEX, styrene, and PCBs were infrequently detected in sediment at low concentrations, and cyanide was not detected in sediment.

Environmental media relevant to the ecological risk assessment that are, or may have been, affected by releases from the Tar Plant include:

- Surface soil across the Tar Plant;
- Surface water in the Ohio River adjacent to the Tar Plant; and
- Sediment in the Ohio River adjacent to the Tar Plant

Exposure of ecological receptors to subsurface soils (defined in the SERA as soils greater than three feet below the ground surface) is likely to be infrequent and is not considered to be significant.

In general, aquatic organisms (plants, invertebrates, amphibians, and/or fish) may be exposed to COCs in sediment and surface water via direct dermal contact, and/or assimilation of, sediment-sorbed chemicals or chemicals in the water column. Chemicals may then enter the circulatory system via partitioning through epithelial tissues of the respiratory system (e.g., gill membranes) or gastrointestinal tract (e.g., following ingestion). Plants, invertebrates, and vertebrates (e.g., fish or amphibians) which are in direct contact with surface water or sediment, may serve as contaminant vectors for indirect exposure to higher trophic levels (i.e., semi-aquatic wildlife) through food chain transfer.

Terrestrial wildlife receptors may be exposed to contamination through several exposure pathways. These pathways include: dermal contact with surface water, sediment, or soil; incidental ingestion of soil; ingestion of water; and ingestion of prey items that have bioaccumulated or bioconcentrated chemicals in their tissue. Primary exposure pathways for terrestrial receptors are incidental soil ingestion and food chain exposures. These exposures are evaluated using food chain models. Plants and soil invertebrates may be exposed to contamination through direct contact with soil.

Exposure pathways for semi-aquatic wildlife are similar to those for terrestrial wildlife except that their exposures are generally limited to aquatic systems and therefore do not include soils.

Identification of Contaminants of Concern

Surface water, sediment, and surface soil data from the Phase I and Phase IA RI field investigations were used in the SERA according to the criteria established by U.S. EPA in "Guidance for Data Usability in Risk Assessment" (U.S. EPA, 1992). The Phase Ia analytical program focused on only those chemicals that were identified as COCs in the draft Phase I RI. These chemicals included BTEX, styrene, PAHs, total phenols, arsenic, cyanide, and ammonia. In addition, PCBs were included as analytes for soil and sediment samples collected during the Phase Ia program. Tables 17, 18 and 19 list the occurrence, distribution and final selection of surface soil, surface water and sediment COCs.

Selection of Assessment and Measurement Endpoints

Endpoints define the ecological attributes to be protected (assessment endpoints) and define measurable characteristics of those attributes that can be used to gauge the degree of impact that may occur (measurement endpoints). Assessment endpoints and associated risk questions for this SERA are:

1. Maintenance of communities and populations of aquatic receptors (fish, invertebrates, and plants) at the Tar Plant similar to those found in reference areas - Are Tar Plant contaminants present in the Ohio River at levels sufficient to adversely affect aquatic receptors (fish, invertebrates, and plants) in the Ohio River?
2. Maintenance of populations of herbivorous waterfowl species such as mallard at the Site similar to those found in reference areas - Are Tar Plant contaminants present in the Ohio River at levels sufficient to adversely affect herbivorous waterfowl species such as mallard?
3. Maintenance of populations of piscivorous (fish-eating) bird species such as belted kingfisher at the Tar Plant similar to those found in reference areas - Are Tar Plant contaminants present in the Ohio River at levels sufficient to adversely affect piscivorous bird species such as belted kingfisher?
4. Maintenance of herbivorous semi-aquatic mammal species such as muskrat at the Tar Plant similar to those found in reference areas - Are Tar Plant contaminants present in the Ohio River at levels sufficient to adversely affect herbivorous semi-aquatic mammal species such as muskrat?
5. Maintenance of omnivorous semiaquatic mammal species such as raccoon at the Tar Plant similar to those found in reference areas - Are Tar Plant contaminants present in the Ohio River at levels sufficient to adversely affect omnivorous semi-aquatic mammal species such as raccoon?
6. Maintenance of communities of terrestrial plants and invertebrates at the Tar Plant similar to those that would be expected in commercial/industrial urban environments - Are Tar Plant contaminants in surface soil at the Tar Plant present at levels sufficient to adversely affect communities of terrestrial plants and invertebrates?
7. Maintenance of worm-eating small birds such as American robin at the Tar Plant similar to those found in reference areas - Are Tar Plant contaminants in surface soil at the Tar Plant present at levels sufficient to adversely affect worm-eating small birds such as American robin?
8. Maintenance of predatory birds such as American kestrel at the Tar Plant similar to those found in reference areas - Are Tar Plant contaminants in surface soil at the Tar Plant present at levels sufficient to adversely affect predatory birds such as American kestrel?
9. Maintenance of herbivorous small mammal species such as meadow vole at the Tar Plant similar to those found in reference areas - Are Tar Plant contaminants in surface soil at the Tar Plant present at levels sufficient to adversely affect herbivorous mammals such as meadow vole?
10. Maintenance of omnivorous mammal species such as red fox at the Tar Plant similar to those found in reference areas - Are Tar Plant contaminants in surface soil at the Tar Plant present at levels sufficient to adversely affect omnivorous mammal species

such as red fox?

To gauge the degree of potential impact, the measurement endpoints for this SERA included a comparison of media concentrations at the Tar Plant with literature-based screening benchmark values. This provides a conservative screening-level assessment of potential for adverse effects. A second measurement endpoint included the comparison of estimated dietary doses for wildlife receptors with reference doses (referred to as Reference Toxicity Values, or RTVs) obtained from the literature.

7.2.2 Screening-Level Exposure Assessment

Potential exposure pathways for ecological receptors are summarized in Table 20. Ecological receptors at the Tar Plant are broadly grouped into three general categories based on habitats: aquatic; semi-aquatic; and terrestrial.

The SERA was based upon a reasonable maximum exposure (RME) scenario that may overestimate risks and is unlikely to underestimate risks. RME Exposure Point Concentrations (EPCs) were developed in accordance with U.S. EPA guidance as the lower of the maximum concentration or the 95 UCL on the arithmetic mean concentration. Although the SERA relies largely on RME EPCs, a central tendency exposure (CTE) scenario was also performed. CTE EPCs are used to further characterize hazards to aid in planning future activities for the BERA. EPCs are presented in Tables 21, 22 and 23 for Tar Plant surface soil, surface water, and sediment, respectively.

For this SERA, food chain modeling was conducted to help determine whether or not the food chain is likely to be a significant exposure pathway. Receptors evaluated in the food chain model include the following:

Receptor	Surface Soil	Surface Water	Sediment	Biota
American Robin	√	√		√
American Kestrel		√		√
Meadow Vole	√	√		√
Red Fox	√	√		√
Mallard		√	√	√
Belted Kingfisher		√		√
Muskrat		√	√	√
Raccoon		√	√	√

Table 8.13 of the Phase Ia RI summarizes receptors, exposure assumptions and data sources for each receptor evaluated in the food chain model. Two exposure areas are evaluated: Tar Plant surface soil and the Ohio River.

In the SERA, conservative assumptions were made regarding exposure areas for the receptors, bioavailability and body weight, food ingestion rates and dietary consumption. For example, it was assumed that the chemicals are 100% bioavailable to the receptor. The upstream river, which represents background conditions, is assumed to have an exposure area large enough so that all receptors are assumed to forage entirely within this background area (1000 hectares was assumed since the largest foraging range is 540 hectares). The Tar Plant exposure areas are large enough so that robin, vole, kingfisher, and mallard are assumed to forage exclusively within the Tar Plant (i.e., their foraging ranges are smaller than the exposure areas presented above). Appendix F3 of the Phase Ia RI presents more detailed information regarding exposure parameters and assumptions for each receptor

7.2.3 Screening-Level Effects Assessment

The screening-level effects assessment identifies and describes the ecological screening benchmarks and RTVs used to evaluate potential effects to aquatic and semi-aquatic receptors. These benchmarks and RTVs include regulatory criteria/guidelines and literature-based ecotoxicological endpoints for analytes detected in environmental media at the Tar Plant. Screening toxicity values used to screen COCs in surface soil, surface water, and sediments were derived from the literature. The values selected are based on growth, reproductive, or mortality endpoints for aquatic life, plants, soil invertebrates, and/or wildlife.

For both terrestrial and semi-aquatic wildlife, dose-based benchmarks for use in the food chain model were derived from the literature. The following hierarchy, in order of decreasing preference, was used to identify toxicity values for wildlife measurement endpoint receptors: (1) chronic no observable adverse effects level (NOAEL); (2) subchronic NOAEL; (3) chronic lowest observable adverse effect level (LOAEL); (4) subchronic LOAEL; and (5) estimates of acute lethal dose affecting 50 percent of test organisms (LD50). Best professional judgment was used to identify the most appropriate study and corresponding toxicity value for RTV selection if more than one toxicity study met the set of qualifying criteria applicable for study endpoint and exposure duration. RTVs were adjusted to approximate NOAEL and LOAEL values from other endpoints (e.g., LD50s), if necessary.

7.2.4 Screening-Level Risk Characterization

The screening-level risk characterization combines the results of the exposure and effects assessments in a weight-of-evidence approach to characterize the risks of adverse effects to ecological receptors from exposure to COCs. The results of the benchmark comparisons are discussed, and conclusions regarding the potential for adverse effects to ecological receptors are made by considering the magnitude of exceeding various benchmarks, the extent of contamination across the Tar Plant, and background contribution to the hazard quotient (i.e., relative to those at background locations).

Ecological risk was estimated numerically using the Hazard Quotient (HQ) approach. The HQ is a ratio, which can be used to estimate if harmful effects are predicted or not due to the contaminant in question. An HQ that exceeds 1 indicates that adverse effects from a COC may be experienced by the receptor.

The risk characterization also includes an evaluation of background contribution to the HQs. The incremental HQ identifies that portion of the HQ that may be related to the Tar Plant (i.e., cannot be attributed to background). Incremental HQs were used in the SERA to differentiate between hazards that are associated with the Tar Plant and those that are considered attributable to background conditions.

7.2.5 Screening-Level Summary and Conclusions

This section summarizes the findings of the SERA. Tables 24, 25 and 26 present the hazard quotient analysis for soil, surface water, and sediment respectively. The results of the SERA suggest that PAHs in the soil present a hazard to soil invertebrates, worm-eating birds and predatory birds. HQs greater than or equal to 100 are scattered across the Tar Plant. No background surface soil data are available, and therefore incremental hazards could not be evaluated.

The results of the SERA suggest that adverse effects in aquatic receptors from exposure to COCs in surface water are possible. Additionally, based on sediment screening criteria and further evaluation of PAHs, using U.S. EPA's Equilibrium Partitioning Sediment Benchmark approach, adverse effects to benthic organisms (direct contact) and piscivorous birds (food chain) are possible due to PAHs in sediment. Figure 7 shows the incremental risk to benthos from PAH exposure adjacent to the Tar Plant compared to risks from PAH exposure upstream. While risk to benthos may be posed from upstream sources, it is clear that there is a risk from exposure to sediments impacted by the Site.

7.3 Uncertainties

Some level of uncertainty is introduced into both the human health and ecological risk characterization process every time an assumption is made. In regulatory risk assessment, the methodology dictates that assumptions err on the conservative side of exposure and risk. The effect of using numerous assumptions that may overestimate potential exposure provides a conservative estimate of potential risk.

The large number of assumptions made in the risk characterization could potentially introduce a great deal of uncertainty. Any one individual's potential exposure and subsequent potential risk are influenced by their individual exposure and toxicity parameters and will vary on a case-by-case basis. Understanding the uncertainties in the assessment should result in decisions that are more informed.

At least three sources of uncertainties exist in the HHRA and SERA:

- Uncertainty around environmental data;
- Uncertainty around exposure assumptions; and
- Uncertainty related to toxicity assumptions.

7.3.1 Uncertainty In Environmental Data

Sampling plans were used and followed for both phases of the RI to determine and evaluate the full nature and extent of contamination to support the analysis. The sampling plans in turn relied on existing data sets and previous investigations to help best identify sampling locations to fill existing data gaps at the Tar Plant. In addition, seasonal variation of concentrations may occur because of fluctuations in the water levels. In addition, sampling and analytical procedures are likely to introduce variability.

Sample quantitation limits (SQLs) that are substantially elevated (e.g., more than ten-times greater than conservative screening values) have the potential to bias the outcome of the risk assessment. At the Tar Plant, SQLs for VOCs, PAHs, and Aroclor-1248 in soil, benzene and naphthalene in ambient air, and benzene, naphthalene, and m,p-xylene in soil vapor, were above risk-based screening values in some samples. There are two principal ways that elevated SQLs can affect the risk assessment: COC selection and EPC derivation.

For data sets with highly elevated SQLs and positively detected concentrations below the SQLs, 95% UCL values used as EPCs can be biased high, and this is exacerbated if the number of samples included in the data set is small or there if there is a large amount of variability between the detected concentrations and the SQLs. This is because the 95% UCL values are calculated using the reported concentrations for results reported as positively detected, and one-half the SQL for results reported as non-detect. To address this uncertainty, the Phase Ia Work Plan and field investigation included re-sampling soil in the vicinity of Phase I locations where soil samples were reported with very high SQLs, and expanding the area and density of sampling across the Tar Plant. In preparation of the Phase Ia risk assessments, elevated SQLs were removed from the data sets used to calculate EPCs, as appropriate. However, the results of the Phase IA investigation indicate that the extent of PAH and BTEX contamination at the Tar Plant is more expansive than was indicated in the Phase I RI. In addition, a number of the analytical results for PAHs and BTEX are consistent with or higher than the concentrations reported in the Phase I RI. Consequently, SQLs associated with the Phase I soil data that appeared to be highly elevated (i.e., outliers) with respect to the soil data set, no longer appear to be highly elevated or outliers when considered in the context of the Phase Ia soil data. Therefore, SQLs elevated above risk-based screening levels in the soil data sets do not contribute a bias to the soil EPCs.

<u>Treatment of Field Duplicate Samples</u>

U.S. EPA has established guidelines indicating that the results for duplicate pairs should be within 50% of each other; such a finding indicates that variability is attributable to the normal heterogeneity of chemical concentrations in an environmental medium, and not to the precision of the analytical methods used to measure concentrations. Evaluation of duplicate pair results indicated that all or most of the PAHs in three soil samples and one sediment sample showed variability above the project RPD goal of 50%. These samples include soil samples OU3-DPS31-0004, OU3-DPS33-0004, OU3-DPS47-0004, and sediment sample OU3-SD31-0000. In addition, naphthalene results for the duplicate pair associated with soil sample OU3-DPS51-0004 exceeded the 50% RPD goal. Therefore, the duplicate sample results indicate that for the majority of samples, variability in measured concentrations between the original and field duplicate samples is representative of the normal heterogeneity of PAH concentrations in the soil and sediment.

Treatment of Non-Detects

The risk assessment evaluated non-detects (censored data) by assigning a value equal to one-half the non-detect value to each non-detect result. This approach ensures that exposure estimates assume that COCs reported as non-detect are actually present in a medium at a value equal to one-half the non-detect value. This likely results in a combination of over estimating and under estimating COC concentrations for non-detects, because a chemical reported as non-detect can hypothetically be non-present (i.e., a concentration of '0') or present at a value just below the detection limit (i.e., a concentration of >99% of the detection limit).

For the COCs that contributed substantial risks (i.e., the COCs, which primarily include PAHs), the frequency of detection was generally greater than 90%. It is evident that risks for these COCs are well above applicable risk limits.

SERA Uncertainties

Soils with a top depth of 0 foot bgs and bottom depth of 3 feet bgs or less were classified as surface soils. Surface soils are typically 0 to 1 foot or 0 to 2 feet bgs, representing what is generally considered to be the typical zone of biological activity. Thirty-six surface soil samples had a sampling interval of 0 to 2 feet bgs, but the majority of surface soil samples (n=66) had a sampling interval of 0 to 3 feet bgs. Samples that include the deeper soils may represent conditions below the typical zone of biological activity. Average concentrations used in the SERA (0-3 feet bgs) are slightly lower than those that would have been calculated using 0-2 feet bgs samples, and therefore inclusion of these samples may have slightly underestimated risks to terrestrial ecological receptors.

Several PAHs detected in surface water samples were also detected in equipment blanks. The PAHs in samples that were directly associated with the equipment blanks were U qualified if concentrations were similar to those detected in equipment blanks. However, PAHs in samples collected on other days that were present at similar concentrations to those detected in the equipment blanks were not U qualified. This may have slightly overestimated hazards associated with PAHs in surface water.

7.3.2 Uncertainty in Exposure Assumptions

A number of uncertainties are associated with assumptions made in the exposure assessment. Areas of uncertainty include the calculation of intakes and the selection of exposure parameters. Uncertainties regarding exposure assumptions result from the variability of the different parameters, such as ingestion rates and exposure durations both within and across populations. Best estimates from data sources compiled by regulatory agencies were used in assessing potential exposures. How well these assumptions fit the community is unknown. The 95th percentile values from the exposure ranges were incorporated into the exposure assumptions to make the assessment more reflective of community demographics. Assumptions of resource use patterns may have included unlikely scenarios, or conversely, missed likely uses. In any case, because of the use of the 95th percentile values and conservative assumptions for potential exposures reflected in the RME, the both HHRA and SERA should provide reasonable, conservative estimates of risk.

Exposure Area for Construction Worker Scenario

The construction worker exposure scenario was evaluated using the entire Tar Plant area as the exposure area. If a specific re-development plan for the Tar Plant was known, exposure areas based on that plan could be identified, and EPCs and risks could be developed for each of the exposure areas. In the absence of a specific re-development plan for the Tar Plant, it was assumed that the entire Tar Plant area could be subject to re-development, and hence the entire Tar Plant area is defined as a single exposure area. This could result in either over or underestimation of risk. However, a review of the soil data indicated that soil COCs are distributed fairly ubiquitously at elevated concentrations and there are no "hot spots." Based on the EPCs (95% UCL values) developed from the Tar Plant-wide data sets, the risk assessment concluded that health risks associated with construction worker contact to soil were in excess of applicable risk limits.

PAHs in Surface Water

Cancer risks for future recreational visitors who are assumed to swim in the Ohio River were in excess of Ohio EPA risk management criteria due to the risk contribution from three PAHs in surface water: benzo(a)pyrene, with a cancer risk of $3x10^{-5}$; benzo(a)anthracene with a cancer risk of $3x10^{-6}$; and benzo(b)fluoranthene with a cancer risk of $3x10^{-6}$. A review of analytical data for surface water samples and paired surface water/sediment samples provides evidence that the detections of these three PAHs in surface water were likely a reflection of sediment particulates that were entrained in the water samples, and not a reflection of surface water quality (i.e., constituents dissolved in surface water). While more details are provided in Section 7.4.3 of the Phase Ia RI report, the basis for this conclusion is that the three PAHs that contributed risk in surface water have very low solubility (less than 0.01 mg/L) and very high partition coefficients; there is no correlation between bulk sediment concentrations and the concentrations reported in paired surface water samples; and the predicted surface water concentrations of benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene are similar to the measured concentrations in each of the samples, yet the predicted surface water concentrations of more soluble PAHs are many times higher than the measured concentrations. If the presence of PAHs in surface water was due to dissolution, the opposite relationship would be expected. This may have resulted in an overestimation of risk.

SERA Uncertainties

The exposure area for the river was assumed to extend halfway across the river. Given the distance and flow rate in the river, this likely overestimates the exposure area.

Tissue concentrations in prey items were estimated by multiplying soil or sediment EPCs by literature-based bioaccumulation factors. This may have overestimated or underestimated hazards to predatory wildlife such as the kingfisher, raccoon, kestrel, and fox.

Background surface soil data are not available, and therefore incremental hazard could not be evaluated for surface soil exposures.

7.3.3 Uncertainty in Toxicity Assumptions

Assumptions of toxicity at expected exposure doses were based on unit exposure values determined by regulatory agencies for the HHRA. Because of uncertainties in the studies used in determining toxicity, single to multiple order-of-magnitude adjustments were made in the process of determining safe exposure levels. Therefore, it is anticipated that the values will tend to overestimate expected toxicity at a given level of exposure.

Although there may be sensitive subsets of the population at the Tar Plant, the toxicity reference values incorporate uncertainty factors that should be protective of these sensitive subpopulations. Combined with the RME exposure assumptions, the net result of the evaluation should be protective of those members of the population.

Lack of Inhalation Dose-Response Values

Inhalation RfCs are available for all of the volatile COCs but are not published for many of the remaining COCs at the Tar Plant. As indicated in this HHRA, volatile inhalation exposures are associated with risks several orders of magnitude greater than dust inhalation exposures. Therefore, the lack of inhalation RfCs and the lack of risk-quantification for non-volatile COCs to which exposure in dust may occur should not represent an uncertainty that affects the conclusions of the HHRA.

SERA Uncertainties

Surface water benchmarks are not available for 1,1,2-trichloro-1,2,2-trifluoroethane and cyclohexane, so hazards associated with these COC could not be quantified.

Sediment benchmarks are not available for several COCs, including cyclohexane, methyl acetate, and methylcyclohexane, so hazards associated with these analytes could not be quantified.

Benchmarks for the food chain model were derived from literature-based studies. Benchmarks are generally not available for each receptor, and therefore benchmarks must be derived based on studies on other species, which may be more or less sensitive than the receptors at the Site. As discussed in Appendix F3 of the Phase Ia RI, uncertainty factors were used to extrapolate between a LOAEL and NOAEL value for chemicals lacking a NOAEL. Use of non-chemical specific uncertainty factors may over-or underestimate toxicity and therefore risks, associated with a chemical.

7.4 Basis for Remedial Action

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or potential releases of hazardous substances into the environment. The response action is warranted because:

1. Surface soil and subsurface soil COCs are present in concentrations that pose an unacceptable risk (either a carcinogenic risk greater than 1 x 10^{-6} or a noncarcinogenic HQ greater than 1) to human health and the environment;

2. Sediment COCs are present in concentrations that pose an unacceptable risk to aquatic and semi-aquatic non-human receptors; and

3. Soil gas is contaminated and will pose vapor intrusion risk to future office workers if buildings are built, or to future construction workers, if excavations occur.

Benzo(a)pyrene is the predominant cPAH accounting for approximately 70% or more of the risk in all human health soil exposures evaluated. The HHRA indicates that the most sensitive receptor is the commercial/industrial outdoor worker in an excavation or grading exposure scenario. A calculated value of 160 μg/kg in soils is protective of this receptor. This concentration was used as the basis of determining the appropriate clean up goals for the Tar Plant.

PAHs pose the predominant risk to aquatic receptors (benthos) in sediments. There is an upstream (background) risk from PAH in the Ohio River from other sources. However, as previously stated, there are risks elevated above background levels in sediments adjacent to the Tar Plant; this is evident in the comparison of the environmental sediment toxicity benchmark unit (ESBTU) from upstream to those adjacent to the Site. The concentration in sediments that generates a ∑ESBTU greater than background (e.g. an ∑ESBTU greater than 10.0) will be used as a clean up goal. These values may be refined further during the design of the sediment remedial action.

8.0 Remedial Action Objectives

The Remedial Action Objectives (RAOs) provide general descriptions of what the Superfund cleanup is designed to accomplish. The RAOs are established on the basis of the nature and extent of the contamination, the resources that are currently and potentially threatened, and the potential for human and environmental exposure. The remedial goals are media-specific, quantitative goals that define the extent of cleanup required to achieve the RAOs. These goals serve as the design basis for the selected remedies identified in this ROD.

8.1 Basis and Rationale for Remedial Action Objectives

Remedial action at the Allied Chemical and Ironton Coke Site Operable Unit 3, Tar Plant, is warranted because:

- Direct contact with surface and subsurface soil at the main parcel, and surface soil at the river parcel, are associated with cancer risks that exceed applicable NCP and Ohio EPA risk management criteria.

- Potential exposures to vapors in air by construction workers during any future active excavation and grading of the Tar Plant in support of a redevelopment project are associated with cancer and non-cancer risks in excess of NCP and Ohio EPA risk management criteria due to benzene, toluene, and naphthalene. In addition there would be direct contact cancer risk in excess of NCP and Ohio EPA risk management criteria due to PAHs in soil.

- Adverse effects to benthic organisms (direct contact) and piscivorous birds (food chain) are possible due to PAHs in sediment.

Using RME assumptions, the cumulative excess lifetime carcinogenic risk to human health exceeds the acceptable risk range of 10^{-6} to 10^{-4} for construction workers, future workers and other use scenarios. There is also a potential for non-carcinogenic risks to those same receptors.

Additionally, surface soils and sediments pose risk to terrestrial and aquatic non-human receptors at concentrations that exceed generic ecotoxicological benchmarks. This indicates potential for risk to these receptors.

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from the actual or threatened releases of hazardous substances into the environment.

8.2 Risks Addressed by the Remedial Action Objectives

Implementation of the selected remedies is expected to stop exposure of humans to concentrations of PAHs and arsenic in soil that exceed carcinogenic and non-carcinogenic acceptable risk levels. Additionally, the selected remedies will prevent and/or mitigate exposure of terrestrial ecological receptors to soils with contaminant concentrations that exceed soil screening levels protective of those species. The potential cancer risk associated with inhalation of vapors in future on-site buildings will be addressed by requiring vapor mitigation systems in any buildings. Excavation and/or covering contaminated sediments will mitigate exposure of benthic and aquatic species to contaminated sediments.

8.3 Remedial Action Objectives for Soil

Remedial Action Objectives (RAOs) developed for the Tar Plant assume that future use of the Tar Plant will remain consistent with previous, that is, industrial or commercial use. Currently, the Tar Plant is vacant. Soils that are the subject of RAOs are surface and subsurface soils located on the main parcel and river parcel. RAOs for soil include:

- Prevent human ingestion/direct contact with soils containing PAHs that exceed applicable NCP and Ohio EPA management criteria for applicable exposure scenarios;
- Prevent exposure of terrestrial invertebrates to PAHs at concentrations ecological risk assessment calculations indicate may be harmful to them;
- Prevent exposure of worm-eating birds to PAHs in terrestrial invertebrates at concentrations ecological risk assessment calculations indicate may be harmful to populations of worm-eating birds;
- Prevent exposure of predatory birds to PAHs at concentrations ecological risk assessment calculations indicated may be harmful to populations of predatory birds; and

- Reduce, to the extent practical, the leaching of contaminants in soil that may contribute to groundwater contamination above NCP and/or Ohio EPA risk management criteria.

8.4 Remedial Action Objectives for Sediment

RAOs developed for the Tar Plant assume that future use of the Ohio River adjacent to the Tar Plant will remain either industrial/commercial or that future use may include riverside parks or other recreational use. RAOs for sediment include:

- Prevent human direct contact with sediment containing PAHs that exceed applicable NCP and Ohio EPA management criteria for future exposure scenarios; and
- Prevent benthic invertebrates from direct contact with sediment containing PAHs that exceed PRGs (i.e., the ΣESBTUs calculated for the samples that represent background for the Ohio River).

8.5 Remedial Action Objectives for Vapor Intrusion

Soil vapor data indicates a potentially unacceptable risk to Tar Plant workers during future excavation activities as well as indoor air inhalation in any potential buildings. As a result, the following RAOs have been developed for risks associated with air as it relates to soil vapor:

- Prevent inhalation of vapors in indoor air in possible future buildings in excess of NCP and Ohio EPA risk management criteria. Risks currently are driven by benzene; and
- Prevent inhalation of vapors by construction workers during any future grading and/or excavation activities. Risks currently are driven by benzene, toluene, and naphthalene.

9.0 Description of Alternatives

The following are the alternatives from the FS that EPA fully evaluated for each media:

<u>Soil</u>

Alternative Soil-1:	No Further Action
Alternative Soil 3a:	Soil Cover
Alternative Soil-3b:	Low-Permeability Cover
Alternative Soil 4a:	Limited Excavation, Offsite Disposal, and Soil Cover
Alternative Soil-4b:	Limited Excavation, Offsite Disposal, and Low-Permeability Cover
Alternative Soil-5:	Extensive Excavation and Offsite Disposal
Alternative Soil-6a:	Limited Excavation, Onsite Consolidation, and Soil Cover
Alternative Soil-6b:	Limited Excavation, Onsite Consolidation, and Low-Permeability Cover

<u>Air</u>

Alternative Air-1:	No Further Action
Alternative Air-2:	Institutional Controls

Sediment

Alternative Sediment-1:	No Further Action
Alternative Sediment-2:	Monitored Natural Recovery
Alternative Sediment-3:	In-Situ Capping
Alternative Sediment-4:	Dredging and Offsite Disposal
Alternative Sediment-5:	Combination of Dredging and Offsite Disposal and In-Situ Capping

9.1 Description of Remedy Components

Each of the alternatives are briefly described below. More detailed information about each of the alternatives can be found in the April 26, 2007 Feasibility Study Report and in the June 15, 2007 Feasibility Study Report Addendum, both of which are included in the Administrative Record for the Tar Plant.

Soil

Alternative Soil-1: No Further Action

Description of Alternative: Under this alternative, no active remediation would occur at the site and no monitoring would be conducted to assess the overall condition of the Tar Plant over time. Naturally occurring processes (e.g., half-life decay, erosion, sedimentation) would occur on their own over time. No institutional controls would be put in place and no operation and maintenance activities would be conducted. Evaluation of the No Action alternative is required by the NCP and provides a baseline against which the other potential remedial alternatives are evaluated.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: There is no containment component associated with this remedy.

Costs: Zero

Alternative Soil 3a: Soil Cover

Description of Alternative: This alternative would include the installation of a soil cover system over portions of the Tar Plant with soil contamination with a potential cancer risk above 10^{-6} (which corresponds to a benzo(a)pyrene concentration [the predominant risk driver] of 160 $\mu g/kg$ in soil). Areas identified as having a potential ecological risk would also be covered. As shown on figure 8, the covered area would include the majority of the area on the main parcel and river parcel. The soil cover system would create a physical barrier to direct contact with contaminated soils by human and ecological receptors. Institutional controls would be implemented, and inspections would be conducted periodically to ensure the soil cover remains intact and that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports. The key components of the alternative are:

- Pre-Design Studies;
- Installation of a Soil Cover;
- Institutional Controls and Inspections; and
- Five-Year Reviews.

Pre-design studies would include a topographic survey of the main parcel and river parcel.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: This alternative includes a soil cover as a physical barrier to exposure by humans and ecological receptors to COCs in soils. There currently is a fence around the main parcel of the Tar Plant. This fence will remain under this alternative.

Costs: The estimated present worth of this alternative is $3.9 million. This estimate is based on a less than one year construction period followed by a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

Institutional Controls: Restrictive covenants that run with the land and that bind all future owners and users of the property would be executed and recorded in the real property record. Such covenants would prohibit residential use of the property, prohibit the use of onsite groundwater, prohibit compromising or otherwise degrading the cover systems, and require that U.S. EPA approved monitoring or institutional controls be in place prior to the undertaking of any construction work on the property or the occupancy of any structures to be built on the property. U.S. EPA and Ohio EPA would be express third-party beneficiaries to the restrictive covenants with the right to enforce the restrictive covenants. The restrictive covenant would include language that approval of U.S. EPA and Ohio EPA would be required as a condition precedent to any modifications of the restrictive covenants.

An Institutional Control Implementation and Assurance Plan (ICIAP) would be prepared for the Site. The ICMP would include a checklist of elements to be assessed during regularly scheduled onsite inspections to verify compliance with all institutional controls. For cost estimating purposes, it is assumed that the institutional control inspections would be performed once per year.

*Operation and Maintenance **Activities:*** Operation and Maintenance (O&M) activities for this alternative will be to ensure that the soil cover remains intact; the engineering controls are in place and in working order; and the ICs are in place.

Monitoring Requirements: Under CERCLA 121(c), any remedial action that results in contaminants remaining on-site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative would consist of conducting a Site visit and interviews, evaluating environmental monitoring data, institutional control reports, and reviewing the ROD requirements and ARARs. The assumptions of the risk assessment would be reviewed for appropriateness and upon consideration of available monitoring data, ARARs, institutional control inspection reports, and results of the Site visit and interviews, a conclusion would be made concerning the protectiveness of the remedy.

Alternative Soil-3b: Low-Permeability Cover

Description of Alternative: This alternative includes all components of Alternative 3a except for the change from a soil cover to a low-permeability cover system. Specifically, this alternative covers all soils contaminated at the 10^{-6} risk level which corresponds to a benzo(a)pyrene concentration of 160 μg/kg. Figure 8 denotes this area for the most restrictive exposure pathway (i.e., future commercial/industrial outdoor worker). Areas identified as having a potential ecological risk would also be covered. The low-permeability cover system would create a physical barrier to direct contact with contaminated soils by human and ecological receptors. Institutional controls would be implemented, and inspections would be conducted periodically to ensure the soil cover remains intact and that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports.

Costs: The estimated present worth of this alternative is $5.6 million. This estimate is based on a less than one-year construction period followed by a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

Alternative Soil 4a: Limited Excavation, Off-Site Disposal, and Soil Cover

Description of Alternative: This alternative includes the removal and off-site disposal at a landfill of up to 5 feet of contaminated soil from the northern portion of the main parcel and from a portion of the river parcel. Figure 8 denotes the area for the most protective exposure pathway at risk level of 10^{-6} (which corresponds to 160 μg/kg benzo(a)pyrene) where possible excavation would take place. A soil cover would be installed on the southern main parcel, and on areas of the northern main parcel and river parcel under those excavation scenarios where potential ecological risks would remain after excavation. Areas of the riverbank disturbed by excavation on the river parcel would be restored as described in Alternative Soil-3 (soil cover).

Institutional controls would be implemented, and Site inspections conducted periodically to ensure the soil cover remains intact and that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports. The key components of the alternative are:

- Pre-Design Studies;
- Excavation of Shallow Soil;
- Installation of a Soil Cover;
- Institutional Controls and Inspections; and
- Five-Year Reviews.

Pre-design studies would include a topographic survey of the main parcel and river parcel.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: This alternative includes a soil cover as a physical barrier to exposure by humans and ecological receptors to COCs in soils. There currently is a fence around the main parcel of the Tar Plant. This fence will remain under this alternative.

Costs: The estimated present worth of this alternative is $12.4 million. This estimate is based on a less than one year construction period followed by a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

Institutional Controls: Restrictive covenants that run with the land and that bind all future owners and users of the property would be executed and recorded in the real property record. Such covenants would prohibit residential use of the property, prohibit the use of onsite groundwater, prohibit compromising or otherwise degrading the cover systems, and require that U.S. EPA approved monitoring or institutional controls be in place prior to the undertaking of any construction work on the property or the occupancy of any structures to be built on the property. U.S. EPA and Ohio EPA would be express third-party beneficiaries to the restrictive covenants with the right to enforce the restrictive covenants. The restrictive covenant would include language that approval of U.S. EPA and Ohio EPA would be required as a condition precedent to any modifications of the restrictive covenants.

An ICIAP would be prepared for the Site. The ICIAP would include a checklist of elements to be assessed during regularly scheduled onsite inspections to verify compliance with all institutional controls. For cost estimating purposes, it is assumed that the institutional control inspections would be performed once per year.

Operation and Maintenance Activities: Operation and Maintenance (O&M) activities for this alternative will be to ensure that the soil cover remains intact; the engineering controls are in place and in working order; and the ICs are in place.

Monitoring Requirements: Under CERCLA 121(c), any remedial action that results in contaminants remaining on -site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative would consist of conducting a Site visit and interviews, evaluating environmental monitoring data, institutional control reports, and reviewing the ROD requirements and ARARs. The assumptions of the risk assessment would be reviewed for appropriateness and upon consideration of available monitoring data, ARARs, institutional control inspection reports, and results of the Site visit and interviews, a conclusion would be made concerning the protectiveness of the remedy.

Alternative Soil-4b: Limited Excavation, Off-Site Disposal, and Low-Permeability Cover

Description of Alternative: This alternative includes all components of Alternative 4a except for the change from a soil cover to a low-permeability cover system. A low-permeability cover, as described in Soil Alternative 3b, would be installed on the southern main parcel, and a soil cover would be installed on areas outside the excavation areas on the northern main parcel and river parcel under those excavation scenarios where potential ecological risks would remain after excavation. Areas of the riverbank disturbed by excavation on the river parcel would be restored as described in Alternative Soil-3b.

Costs: The estimated present worth of this alternative is $12.7 million. This estimate is based on a less than one-year construction period followed by a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

Alternative Soil-5: Extensive Excavation and Off-Site Disposal

Description of Alternative: Under this alternative, soils that exceed the risk-based exposure criteria for organics (1×10^{-6} or 160 $\mu g/kg$ benzo(a)pyrene in soil) would be excavated and disposed of offsite at an approved landfill. Approximately 1.1 million cubic yards of contaminated soil would be excavated (see the excavation limits on Figure 8). Soil in the vadose zone containing DNAPL, PAHs, VOCs and arsenic at concentrations that could pose a threat to groundwater would remain. An excavation of this size and depth would require a carefully developed excavation approach. Details on the magnitude of an excavation of this size are presented in the Feasibility Study Addendum, which is in the Administrative Record. Particular care would be necessary where existing structures (roadways, rail lines, utilities, etc.) require protection. Since workers would actually be located within the excavation, inhalation risks would need to be carefully monitored and controlled through the use of personal protective equipment. Excavation within the River Parcel would likely place excavation crews within the 100-year flood boundary, so adequate flood protection measures may need to be devised. After completing the excavation, backfilling would be performed in sequential lifts to ensure stable and safe working conditions. A strategy for characterizing soils for disposal would need to be developed, as it would not be practical to temporarily stage the large quantities of excavated soils while awaiting analytical results. A transportation plan would also be required to deal with the extensive truck traffic necessary to accomplish offsite disposal of the excavated soils. Finding disposal sites with adequate capacity for this large quantity of soil would also pose a formidable challenge. The key components of the alternative are:

- Pre-Design Studies;
- Excavation of Soil to Water Table;

- Institutional Controls; and
- Five-Year Reviews.

Pre-design studies would include a topographic survey of river parcel and geotechnical study for the design of the excavation support system and the stream bank restoration.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: This alternative includes an extensive excavation and backfill with a soil cover as a physical barrier to exposure by humans and ecological receptors to COCs remaining at depth in soils and in DNAPL. There currently is a fence around the main parcel of the Tar Plant. This fence will remain under this alternative.

Costs: The estimated present worth of this alternative is $134.5 million. This estimate is based on a five-year construction period followed by a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

Institutional Controls: Restrictive covenants that run with the land and that bind all future owners and users of the property would be executed and recorded in the real property record. Such covenants would prohibit residential use of the property, prohibit the use of onsite groundwater, prohibit compromising or otherwise degrading the cover systems, and require that U.S. EPA approved monitoring or institutional controls be in place prior to the undertaking of any construction work on the property or the occupancy of any structures to be built on the property. U.S. EPA and Ohio EPA would be express third-party beneficiaries to the restrictive covenants with the right to enforce the restrictive covenants. The restrictive covenant would include language that approval of U.S. EPA and Ohio EPA would be required as a condition precedent to any modifications of the restrictive covenants.

An ICIAP would be prepared for the Site. The ICIAP would include a checklist of elements to be assessed during regularly scheduled onsite inspections to verify compliance with all institutional controls. For cost estimating purposes, it is assumed that the institutional control inspections would be performed once per year.

Operation and Maintenance Activities: Operation and Maintenance (O&M) activities for this alternative will be to ensure that the soil cover remains intact; the engineering controls are in place and in working order; and the ICs are in place.

Monitoring Requirements: Under CERCLA 121(c), any remedial action that results in contaminants remaining on-site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative would consist of conducting a Site visit and interviews, evaluating environmental monitoring data, institutional control reports, and reviewing the ROD requirements and ARARs. The assumptions of the risk assessment would be reviewed for appropriateness and upon consideration of available monitoring data, ARARs, institutional control inspection reports, and results of the Site visit and interviews, a conclusion would be made concerning the protectiveness of the remedy.

Alternative Soil 6a: Limited Excavation, On-Site Consolidation, and Soil Cover

Description of Alternative: This alternative includes the removal of up to 5 feet of contaminated soil from the northern portion of the main parcel and from a portion of the river parcel. The excavated soil would then be consolidated onto the southern portion of the main parcel. Figure 8 denotes the area for the most protective exposure pathway at risk level of 10^{-6} (which corresponds to 160 $\mu g/kg$ benzo(a)pyrene) where excavation would take place. The southern main parcel would be covered to address human health and ecological risks associated with the contaminated soil. Areas of the riverbanks disturbed by the excavation would be restored as described in Alternative Soil-3a.

Institutional controls would be implemented, and Site inspections conducted periodically to ensure that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports. The key components of the alternative are:

- Pre-Design Studies;
- Excavation of Shallow Soil;
- Soil Consolidation and Installation of a Soil Cover;
- Institutional Controls and Inspections; and
- Five-Year Reviews.

Pre-design studies would include a topographic survey of the main parcel and river parcel, and geotechnical studies for stream bank restoration.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: This alternative includes a soil cover as a physical barrier to exposure by humans and ecological receptors to COCs remaining at depth soils and in DNAPL. There currently is a fence around the main parcel of the Tar Plant. This fence will remain under this alternative.

Costs: The estimated present worth of this alternative is $6.1 million. This estimate is based on a less than one-year construction period followed by a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

Institutional Controls: Restrictive covenants that run with the land and that bind all future owners and users of the property would be executed and recorded in the real property record. Such covenants would prohibit residential use of the property, prohibit the use of onsite groundwater, prohibit compromising or otherwise degrading the cover systems, and require that U.S. EPA approved monitoring or institutional controls be in place prior to the undertaking of any construction work on the property or the occupancy of any structures to be built on the property. U.S. EPA and Ohio EPA would be express third-party beneficiaries to the restrictive covenants with the right to enforce the restrictive covenants. The restrictive covenant would include language that approval of U.S. EPA and Ohio EPA would be required as a condition precedent to any modifications of the restrictive covenants.

An ICIAP would be prepared for the Site. The ICIAP would include a checklist of elements to be assessed during regularly scheduled onsite inspections to verify compliance with all institutional controls. For cost estimating purposes, it is assumed that the institutional control inspections would be performed once per year.

Operation and Maintenance Activities: Operation and Maintenance (O&M) activities for this alternative will be to ensure that the soil cover remains intact; the engineering controls are in place and in working order; and the ICs are in place.

Monitoring Requirements: Under CERCLA 121(c), any remedial action that results in contaminants remaining on-site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative would consist of conducting a Site visit and interviews, evaluating environmental monitoring data, institutional control reports, and reviewing the ROD requirements and ARARs. The assumptions of the risk assessment would be reviewed for appropriateness and upon consideration of available monitoring data, ARARs, institutional control inspection reports, and results of the Site visit and interviews, a conclusion would be made concerning the protectiveness of the remedy.

Alternative Soil-6b: Limited Excavation, On-Site Consolidation, and Low-Permeability Cover

Description of Alternative: This alternative includes all components of Alternative 6a except for the change from a soil cover to a low-permeability cover system. A low permeability cover, as described in Soil Alternative-3b, would be installed on the southern main parcel, and a soil cover would be installed on areas outside the excavation on the northern main parcel and the river parcel under those excavations scenarios where potential ecological risks would remain outside the excavation areas. Areas of the riverbanks disturbed by the excavation would be restored as described in Alternative Soil – 3b.

Costs: The estimated present worth of this alternative is $6.8 million. This estimate is based on a less than one-year construction period followed by a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

<u>Air</u>

Alternative Air-1: No Further Action

Description of Alternative: Under this alternative, no active remediation would occur at the Tar Plant and no monitoring would be conducted to assess the overall condition of the Site over time. Naturally-occurring processes (e.g., half-life decay, erosion, sedimentation) would occur on their own over time. No institutional controls would be put in place and no operation and maintenance activities would be conducted. Evaluation of the No Action alternative is required by the NCP and provides a baseline against which the other potential remedial alternatives are evaluated.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: There is no containment component associated with this remedy.

Costs: Zero

Institutional Controls: None

Operation and Maintenance Activities: None

Monitoring Requirements: None

Alternative Air-2: Institutional Controls

Description of Alternative: This alternative relies only on institutional controls and five-year reviews to control potential human-health risks from exposure to vapor. This alternative would consist of the following key components:

- Institutional Control and Inspections; and
- Five-Year Reviews.

<u>**Institutional Controls and Inspections**</u>
Restrictive covenants that run with the land and that bind all future owners and users of the property would be executed and recorded in the real property record. Such covenants would prohibit residential use of the property, prohibit the use of on-site groundwater, prohibit compromising or otherwise degrading the cover systems, and require that U.S. EPA approved monitoring or institutional controls be in place prior to the undertaking of any construction work on the property or the occupancy of any structures to be built on the property. Additional restrictions would require that future buildings include measures (e.g., physical barriers, venting, monitoring) to protect indoor workers and that health and safety procedures be established to protect outdoor workers during any excavation or grading activities. Restrictive covenants would be properly recorded in the property records. U.S. EPA and Ohio EPA would be express third-party beneficiaries to the restrictive covenants with the right to enforce the restrictive covenants. The restrictive

covenant would include language that approval of U.S. EPA and Ohio EPA would be required as a condition precedent to any modifications of the restrictive covenants.

An ICIAP would be prepared for the Site. The ICIAP would detail the restrictive covenants to be recorded. The ICIAP would include a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the onsite inspection would include physical barriers, such as fencing, to insure its integrity, verifying warning signs are in place and intact, and no structure or pavement has been disturbed or removed.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: There is no containment component associated with this remedy.

Costs: $75,000.

Operation and Maintenance Activities: See below.

Monitoring Requirements: Under CERCLA 121(c), any remedial action that results in contaminants remaining on-site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative would be considered a statutory review.

Sediment

Alternative Sediment-1: No Further Action

Description of Alternative: Under this alternative, no active remediation and no monitoring would occur to assess the overall condition of the Tar Plant over time. Naturally occurring processes (e.g., half-life decay, erosion, sedimentation) would occur on their own over time. No institutional controls would be put in place and no operation and maintenance activities would be conducted. Evaluation of the No Action alternative is required by the NCP and provides a baseline against which the other potential remedial alternatives are evaluated.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: There is no containment component associated with this remedy.

Costs: Zero.

Institutional Controls: None.

Operation and Maintenance Activities: None.

Monitoring Requirements: None.

Alternative Sediment-2: Monitored Natural Recovery

Description of Alternative: The implementation of monitored natural recovery (MNR) requires that the source of the contamination be controlled followed by an initial assessment of the site and monitoring (every five years). If it is determined that natural recovery is not occurring at a rate that is sufficient to reduce risks within an acceptable time frame, enhanced natural recovery or another contingent remedy may be implemented. Enhanced natural recovery could consist of placing a thin layer of clean sediment over the contaminated sediment to accelerate the recovery process. Some considerations in applying MNR include:

- Stability of the river bottom/sediment resistance to re-suspension;
- Whether natural deposition is occurring;
- Sedimentation rates;
- The potential for natural reductions in contaminant concentrations covering diffuse areas;
- Contaminants that have a low ability to bioaccumulate;
- Expected human exposure is low and/or can be reasonably controlled by institutional controls; and
- Anticipated land uses or new structures would not inhibit the natural recovery process.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: There is no containment component associated with this remedy.

Costs: The estimated present worth of this alternative is $0.7 - 1 million. This estimate includes no construction costs and a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

Institutional Controls: ICs, possibly in the form of restrictive covenants, would be established for the sediment that may prohibit dredging allowing natural sedimentation to occur. These ICs or restrictive covenants would be properly recorded in the property records. U.S. EPA and Ohio EPA would be express third-party beneficiaries to the restrictive covenants with the right to enforce the restrictive covenants. The restrictive covenant would include language that approval of U.S. EPA and Ohio EPA would be required as a condition precedent to any modifications of the restrictive covenants.

An ICIAP would be prepared for the Site. The ICIAP would detail the restrictive covenants to be recorded. The ICIAP would include a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the onsite inspection would include physical barriers (e.g. verifying warning signs are in place and intact) and no structure has been disturbed or removed.

Operation and Maintenance Activities: Operation and Maintenance (O&M) activities for this alternative will be to monitor the progress of the MNR; ensure the engineering controls are in place and in working order; and ensure the ICs are in place.

Monitoring Requirements: Under CERCLA 121(c), any remedial action that results in contaminants remaining onsite at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative would be considered a statutory review.

Alternative Sediment-3: In-Situ Capping with Long-Term Monitoring

Description of Alternative: The contaminated sediment exceeding PRGs would be covered with earthen materials (such as, sand, or gravel, and/or cobbles), engineered materials (such as, geosynthetics or marine mattresses), or a combination of these materials. Design and material selection depends on the nature of the contamination, the physical and hydraulic characteristics of the waterway, long-term plans for the area (i.e., development and maintenance activities), and permitting requirements. One cap design consideration consists of riprap that would be installed as part of any riverbank restoration (see subsection 4.2 of the FS) extending down into the river to act as a portion of the cap and/or as armor protecting the cap. Pre-design studies would be required as part of this remedy to refine the ecological risk assessment results regarding the extent of risk and the extent of contamination.

Design and implementation of this remedy should take into account U.S. EPA's *Contaminated Sediment Remediation Guidance for Hazardous Waste Sites, OSWER 9355.0-85 and* navigational or other uses of the area, as well as the potential for catastrophic natural events adjacent to the Tar Plant.

Treatment Technologies and Materials they will address: There is no treatment associated with this alternative.

Containment Component: This alternative includes a cover over a portion of the sediments as a physical barrier to exposure by aquatic receptors to COCs remaining in the sediments.

Costs: The estimated present worth of this alternative is $1.8 – 3.4 million depending upon the materials and the size of the cap. This estimate includes a six month construction period and a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars. Note that the 30 years is only used for costing purposes.

Institutional Controls: Institutional controls to prevent activities that could damage the cap will be implemented. One such control may include a prohibition of dredging in the area of the cap. Restrictions would be stated as described in the institutional controls for Alternative Sediment - 2.

An ICIAP would be prepared for the Tar Plant. The ICIAP would detail the restrictive covenants to be recorded. The ICIAP would include a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the onsite inspection would include inspection of physical barriers (e.g. verifying warning signs are in place and intact) and evaluation that no structure has been disturbed or removed.

Operation and Maintenance Activities: Operation and Maintenance (O&M) activities for this alternative will be to monitor the cap; ensure the engineering controls are in place and in working order; and ensure the ICs are in place.

Monitoring Requirements: Under CERCLA 121(c), any remedial action that results in contaminants remaining on-site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative would be considered a statutory review.

Alternative Sediment-4: Dredging and Off- Site Disposal

Description of Alternative: Dredging consists of the removal of contaminated sediment from the river bottom, dewatering the sediment, followed by transportation and off-site disposal. Remedial investigation work on river sediment found that there is cobble or hardpan in many areas adjacent to the Site. Therefore, in many locations, there is no fine-grained sediment. At this time, it is assumed that dredging would be completed to either the depth of gravel/cobbles or bedrock (hardpan). The extent of dredging would be based on additional data collection and evaluation during the pre-design studies. The following are key components of this alternative:

- Pre-Design Studies;
- Dredging;
- Dewatering, Transportation, and Disposal; and
- Post-Dredging Sampling and Residual Management

Pre-design studies: Additional data would be collected as part of this remedy to ensure utilization of the best dredging technologies for the specific river conditions and to ensure that turbidity is minimized. The additional data would include, for example: river flow velocities; grain size distribution; sediment shear strength; hydrographic and side-scan sonar surveying; and the United States Army Corps of Engineers' Hydraulic Engineer Center – River Analysis System (HEC-RAS) modeling.

Treatment Technologies and Materials they will address: Treatment of surface water from dewatering of sediments will occur at the on-site wastewater treatment plant to meet site-specific requirements for discharge.

Containment Component: There is no on-site containment component to this alternative.

Costs: The estimated present worth of this alternative is $6.8-9.9 million depending upon the volume of materials dredged and associated disposal costs as a non-hazardous waste. This estimate includes a six-month construction period and a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

Institutional Controls: ICs would not be required with this alternative.

Operation and Maintenance Activities: O&M would not be required with this alternative.

Monitoring Requirements: Because of the practical limitations of removing sediment in a dynamic river environment, some residual contaminated sediment may remain. Following the completion of dredging, verification samples collection would be attempted to assess whether residuals are present. If verification samples can be collected and the results indicate that PRGs are still exceeded, a residual management plan can be implemented. One example of such a plan would be the placement of a layer of sand or cobbles or geotextile on top of the residuals.

Alternative Sediment - 5: Combination of Dredging and Off-Site Disposal and In-Situ Capping

Description of Alternative: This alternative consists of implementing both Alternative Sediment – 3 (In-Situ Capping) and Alternative Sediment – 4 (Dredging and Off-Site Disposal). Combining capping with dredging would limit the volume of material that would need to be dewatered and limit the volume to be disposed (if disposed in a landfill it would affect landfill capacity). Cap design will take into account scouring from physical forces as well as future expected use of the river front adjacent to the Tar Plant, including navigation. Remedial investigation work on river sediment found that there is cobble or hardpan in many areas adjacent to the site. Therefore, in many locations, there is no fine-grained sediment. At this time, it is assumed that dredging would be completed to either the depth of gravel/cobbles or bedrock (hardpan). This alternative may include all of the procedures, controls, and residual management discussed in Alternative Sediment - 3 and 4.

Treatment Technologies and Materials they will address: Treatment of surface water from dewatering of sediments will occur at the on-site wastewater treatment plant.

Containment Component: This alternative includes a cover over a portion of the sediments as a physical barrier to exposure by aquatic receptors to COCs remaining in the sediments.

Costs: The estimated present worth of this alternative is $2.8 – 4.5 million depending upon the volume of materials dredged, associated disposal costs and capping materials used. This estimate is includes a six-month construction period and a 30-year monitoring program, using a discount rate of 5% for all present worth calculations. The total estimated cost is provided in 2007 dollars.

Institutional Controls: Institutional controls to prevent activities that could damage the cap will be implemented. Restrictions would be stated as described in the institutional controls for Alternative Sediment - 2.

Operation and Maintenance Activities: Operation and Maintenance (O&M) activities for this alternative will be to monitor the cap; ensure the engineering controls are in place and in working order; and ensure the ICs are in place.

Monitoring Requirements: Under CERCLA 121(c), any remedial action that results in contaminants remaining onsite at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative would be considered a statutory review.

9.2 Common Elements and Distinguishing Features of Each Remedial Component

This section of the ROD describes those components that are common to each of the remedial alternatives except the No Action Alternative. Common remedial components to all or most of the remedial alternatives include the need for pre-design studies to collect site-specific data for the RD, institutional controls, and Five-Year Reviews.

9.2.1 Pre-design Studies

For the soil alternatives, pre-design studies include a topographic survey of the main and river parcels and a geotechnical study for the stream bank repairs after remedial action. Pre-design studies for the sediment alternatives include: collection of additional data to utilize in design of the caps or to utilize in dredging alternatives to control turbidity. The additional data may include: river flow velocities; grain size distribution; sediment shear strength; and hydrographic and side-scan sonar surveying and modeling.

9.2.2 Institutional Controls

Most of the alternatives include the implementation of ICs to prevent activities that could damage the remedial actions taken. Additionally, there are requirements to implement ICs to prevent residential use of the site; to ensure the construction of vapor control barriers and/or active structure venting in any buildings that may be constructed on the Tar Plant in the future; and to ensure the use of proper safety equipment to ensure the health and safety of construction workers should there be any future construction activities on the Tar Plant.

9.2.3 Five-Year Reviews

Because this remedy will result in hazardous substances, pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review, known as the five-year review, is required for the entire Site. Five-year reviews are required every five years from initiation of construction of the remedies. The five-year review for this operable unit, however, will be conducted in accordance with the schedule for the site-wide five year review. The next five-year review is required to be completed by September 13, 2009. The objective of these five-year reviews will be to confirm that the remedies are, or will be, protective of human health and the environment. If the selected remedies are found to be unprotective, then corrective actions to bring the remedies to a protective level will be taken.

9.2.4 Key Applicable or Relevant and Appropriate Requirements

With the exception of the No Action Alternative, it is assumed that an appropriate design for all retained remedial alternatives can be developed for each media of concern to meet applicable ARARs. The primary difference in soil alternatives is the use of a general soil cap vs. a low-permeability soil cap and on-site vs. off-site disposal of excavated materials. Tables 27 - 29 list the ARARs for the alternatives.

9.2.5 Long-Term Reliability of the Remedy

The magnitude of risk will remain indefinitely if no action is taken at the Tar Plant. All of the alternatives considered for remedial action will provide long-term reliability once in place, provided that ICs remain effective. If the remedy cannot be implemented as planned then U.S. EPA will develop an alternate plan. At this time, U.S. EPA cannot determine the cost for replacement of the remedy, as there is insufficient data for analysis of such circumstances.

9.2.6 Quantities of Untreated Wastes

At this time, quantities of untreated waste cannot be calculated. Pre-design studies will provide estimates of this information. However, there are 27-acres of contaminated soil and less than 1-acre of contaminated sediment in the Ohio River.

9.2.7 Use of Presumptive Remedies

No presumptive remedies are proposed.

9.3 Expected Outcomes of Each Alternative

Implementation of any of the alternatives considered for the Tar Plant, other than the No Action Alternatives, is expected to reduce the human health and ecological risks to terrestrial receptors and the risks to aquatic organisms in the Ohio River adjacent to the Site over time. However, the time required to achieve the RAOs for each site-impacted media varies anywhere from several to thirty years depending on the alternative implemented.

None of the alternatives are expected to change the land use at the Tar Plant as it will likely remain industrial/commercial as long as Honeywell owns the property. Implementation of any of the alternatives, except no action, will reduce risk to human health and the environment.

10.0 Comparative Analysis of Alternatives

When selecting a remedy for a site, U.S. EPA considers the factors set forth in Section 121 of CERCLA by conducting a detailed analysis of the remedial alternatives in accordance with the NCP, U.S. EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (OSWER Directive 9355.3-01) and U.S. EPA's *A Guide to Preparing Superfund Proposed Plans, Records of Decision, and Other Remedy Selection Decision Documents* (OSWER 9200.1-23.P). The detailed analysis consists of an assessment of the individual alternatives against each of the nine evaluation criteria (two threshold, five primary balancing, and two modifying criteria) and a comparative analysis focusing upon the relative performance of each alternative against those criteria. The nine evaluation criteria are described as follows:

Threshold Criteria

1. **Overall Protection of Human Health and the Environment** addresses whether a remedy provides adequate protection of human health and the environment and describes how risks posed by the site are eliminated, reduced or controlled through treatment, engineering, or institutional controls. The selected remedy must meet this criterion.

2. **Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)** addresses whether a remedy will meet the applicable or relevant and appropriate requirements. The selected remedy must meet this criterion or a waiver of the ARAR must be obtained.

Section 121(d) of CERCLA requires that Superfund remedial actions at least attain legally applicable or relevant and appropriate federal and state requirements, standards, criteria, and limitations which are collectively referred to as ARARs, unless such ARARs are waived under CERCLA Section 121(d)(4). Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility citing laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a Superfund site. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that, while not applicable, address problems or situations sufficiently similar to those encountered at the Superfund site that their use is well-suited to the particular site.

In addition to ARARs, guidance materials that have not been promulgated or regulatory standards that are not applicable or relevant and appropriate may be considered (including local/county requirements); these are referred to as items "to be considered" (TBC). While TBCs may be considered along with ARARs, they do not have the status of ARARs. The ARARs and TBCs identified for the site are categorized into three types: chemical-specific; action-specific; and location-specific. Chemical-specific ARARs establish the acceptable amounts or concentrations of a chemical that may be found in, or discharged to, the ambient environment. Action-specific ARARs are technology- or activity-based performance or design requirements associated with the potential remedial activities being considered. Location specific ARARs establish requirements that protect environmentally sensitive areas and other areas of special interest.

In the case of the Tar Plant, chemical-specific ARARs and TBCs were developed for each media affected, and are presented in Table 27. Location-specific ARARs were developed for the natural site features potentially affected and are presented in Table 28. Action-specific ARARs were developed and are presented in Table 29.

The primary chemical specific ARAR is the Ohio EPA Voluntary Action Program generic direct contact standard for commercial/industrial properties. This is considered Relevant and Appropriate by providing generic numerical standards or alternatively allowing for development of site-specific criteria for clean up of soils. The criteria are based on ingestion, dermal contact or inhalation of volatile/particulate emissions outdoors from soils.

The primary location-specific ARARS are the federal and state requirements applicable to floodplain and wetland management. These requirements are applicable at the Tar Plant specifically with respect to the river parcel. Under these requirements, federal agencies are required to evaluate the potential adverse effects of development of a floodplain and to maintain and protect wetlands such that degradation of surface waters does not result in the loss of wetland acreage or function.

The primary action specific ARARs are those relating to capping of solid waste materials and those for disposing of hazardous and/or non-hazardous materials. Most of the Ohio EPA Solid Waste Standards are relevant and appropriate for the selected soil remedy. Any sediment that might be disposed of off-site will be subject to federal and state hazardous waste management standards, RCRA Subtitle C and possibly RCRA Subtitle D requirements.

Primary Balancing Criteria

3. **Long-Term Effectiveness and Permanence** refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met.

4. **Reduction of Toxicity, Mobility, or Volume Through Treatment** addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility or volume of the hazardous substances as their principal element. This preference is

satisfied when treatment is used to reduce the principal threats at the site through destruction of toxic contaminants, reduction of the total mass of toxic contaminants, irreversible reduction in contaminant mobility, or reduction of total volume of contaminated media.

5. **Short-Term Effectiveness** addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction of the remedy until cleanup levels are achieved. This criterion also considers the effectiveness of mitigative measures and time until protection is achieved through attainment of the RAOs.

6. **Implementability** addresses the technical and administrative feasibility of a remedy from design through construction, including the availability of services and materials needed to implement a particular option and coordination with other governmental entities.

7. **Cost** includes estimated capital costs, annual operation and maintenance costs (assuming a 30-year time period), and net present value of capital and operation and maintenance costs, including long-term monitoring.

Modifying Criteria

8. **State Agency Acceptance** considers whether the state support agency concurs with the selected remedy.

9. **Community Acceptance** addresses the public's general response to the remedial alternatives and the preferred alternative presented in the Proposed Plan. The ROD includes a responsiveness summary that summarizes the public comments and U.S. EPA's responses to those comments. The responsiveness summary is included as Appendix A.

The full text of the detailed analysis of the remedial alternatives against the nine evaluation criteria (including both the individual analysis and the comparative analysis) is contained in the April 2007 *Feasibility Study Report* and in the June 2007 *Feasibility Study Addendum* which are included in the Administrative Record. This section of the ROD summarizes the highlights of the comparative analysis.

10.1 Soil Alternatives

The following eight soil alternatives were evaluated for both the main and river parcels:

- Alternative Soil 1: No Further Action
- Alternative Soil 3a: Soil Cover
- Alternative Soil 3b: Low-Permeability Cover
- Alternative Soil 4a: Limited Excavation and Soil Cover
- Alternative Soil 4b: Limited Excavation and Low-Permeability Cover
- Alternative Soil 5: Extensive Excavation and Off-Site Disposal

- Alternative Soil 6a: Limited Excavation, On-Site Consolidation, and Soil Cover
- Alternative Soil 6b: Limited Excavation, On-Site Consolidation, and Low-Permeability Cover

Overall Protection of Human Health and the Environment

Alternatives Soil 3a, 3b, 4a, 4b, 5, 6a and 6b are protective of human health and the environment to the most protective level (10^{-6}) of the risk range (10^{-4} to 10^{-6}) established in the NCP. The use of a low permeability cap in alternatives 3b, 4b and 6b would prevent leaching of contaminants from soils in the unsaturated zone to groundwater. However, the mass of contaminants in the saturated zone would continue to leach to groundwater and be collected by the existing groundwater capture system. Use of the low permeability cap might inhibit the natural attenuation of contaminants in the unsaturated zone via biodegradation and flushing by minimizing the infiltration of fresh, oxygenated precipitation through the unsaturated soils. Alternative Soil – 5 would provide protection from direct contact with soils and leaching of contaminants from soils in the unsaturated zone. However, the large contaminant mass in the saturated zone would continue to leach and be collected by the groundwater capture system. In addition, the groundwater capture system would need to be shut down during the extended period of Site excavation, allowing uncontrolled migration of contaminated groundwater. Alternative Soil – 1 would not be protective since no action would be taken.

Compliance with ARARs

ARARs are not applicable to Alternative Soil 1. Alternatives Soil 3b, 4b, - 5, and 6b all comply with ARARs. Alternatives 3a, 4a and 6a would not comply with Ohio EPA's rules for the construction of solid waste facilities as described in OAC 3745-27-08.

Long-Term Effectiveness and Permanence

Alternatives Soil - 3a, - 3b, -4a, - 4b, - 6a, and -6b provide very similar degrees of long-term effectiveness and permanence and would require the same or very similar use restrictions and maintenance activities on the northern and southern portions of the main parcel and on the river parcel to provide protection from contaminants remaining below the various cover systems. While Alternatives Soil 4a and 4b include the removal of a portion of soil contamination from the Site and offsite disposal at the landfill, significant contamination would remain on the Tar Plant and removal of the soil would not reduce the necessary use restrictions. Alternative Soil – 5 would provide long-term protection by removing contaminated soils above the water table and relocating them to a landfill. While this would address concerns regarding direct contact and contaminant leaching from unsaturated soils to groundwater, a significant contaminant mass in the saturated zone will continue to leach and would require to be collected by the groundwater system. In addition, on-site use restrictions would still be required to maintain long-term effectiveness. Alternative Soil 1 would not provide long-term effectiveness since no action is proposed.

Reduction of Toxicity, Mobility, and Volume through Treatment

None of the soil alternatives reduce toxicity, mobility and volume through treatment.

Short-Term Effectiveness

Alternatives Soil 3a and 3b could be installed the most quickly, and therefore would achieve protection against potential exposures within the shortest period of time. Alternatives Soil - 4a, 4b, 6a, and 6b would take longer due to increased construction complexity associated with excavating soil from the northern portion of the main parcel. Alternative Soil 5 is estimated to require over four years to complete due to the enormous soil volume to excavate, the complex excavation support systems required, and special safety requirements for protection of construction workers. During this extended period, groundwater capture at the Site would cease and contaminated groundwater would migrate uncontrolled.

All soil alternatives would need to control dust from on-site work to protect both onsite workers and the surrounding community. Alternative Soils 3a involves the least amount of earthwork and would involve the lowest potential for adverse impacts associated with contaminated dust to workers and the community. Alternatives Soil – 3b would involve only slightly more earthwork and associated risk of potential adverse impacts. Alternatives Soil 4a, 4b, 6a and 6b would involve an increasing level of earthwork, and therefore, would have an increased potential for adverse impacts associated with contaminated dust. Alternatives Soil – 5 would involve substantially more earthwork, potentially over a four year period. This would result in a substantial increase in the risk of potential adverse impacts to workers and/or the community.

The alternatives involve a wide range of potential adverse impacts to the community associated with increased truck traffic (dust, noise and risk of accidents). Alternatives Soil – 3a, 3b, 6a, and 6b would have the lowest potential for such adverse impacts as these are estimated to require the fewest number of truckloads (3,000). Alternatives Soil 4a and 4b are estimated to require these same 3,000 truckloads but would require an additional 4,500 truckloads to transport excavated soil off site for disposal, significantly raising the risk of adverse impacts. Alternatives Soil 5 would result in by far the greatest risk of truck-related adverse impacts since it is estimated that approximately 114,000 truckloads will be required over a four-year period. Alternative Soil 1 would not provide any short-term effective protection since no action is proposed.

Implementability

Alternative Soil 1 is the most easily implemented alternative since it does not involve any actions. Alternative Soil 3a is most easily implemented since it involves the placement of a relatively simple cover system. Installation of the low-permeability cover on the Main Parcel under Alternative Soil 3b would result in increased installation complexity but is still readily implementable. A low-permeability cover on the river parcel is not implementable due to concerns for hydraulic instability caused by hydrostatic pressure differences between the groundwater and surface water, which could cause the low-permeability cover to fail. Excavation of soils from the northern portion of the main parcel in Alternatives Soil 4a, 4b 6a and – 6b is implementable but is more complex than the work included in Alternatives Soil 3a and 3b. Excavation along the river parcel in Alternatives Soil 4a, 4b, 6a and 6b is complex and involves significant safety issues considering the close proximity of the active railroad line.

Unless an alternative cover system design is developed, soil alternatives that have the low-permeability cover component (i.e., Alternatives Soil 3b, 4b, and 6b) could hinder redevelopment due to increase in grade and concerns regarding construction on, and repair of, the cover system. During design, these concerns would be addressed to the extent feasible by considering alternative cover systems that prevent the infiltration of precipitation, as intended by Ohio EPA regulations and/or (in the case of Alternative Soil 6b) extending the cap area to the north to reduce elevation increases.

Implementation of Alternative Soil – 5 would be the most challenging of all alternatives, due to the depth to which soil would be excavated (i.e., 40 feet on the main parcel and 20 feet on the river parcel). In addition, there are significant concerns that the dynamic driving of the sheet piles necessary to perform the excavation would induce instability in the adjacent, active railroad bed. The railroad bed might settle over time, increasing the risk of an accident and rendering this portion of the railroad unusable until repaired.

Cost

The following are the present worth estimates for the alternatives:

- Alternative Soil 1: No Further Action: $0
- Alternative Soil 3a: Soil Cover: $3.9 M
- Alternative Soil 3b: Low-Permeability Cover: $5.6M
- Alternative Soil 4a: Limited Excavation, Off-Site Disposal and Soil Cover: $12.4 M
- Alternative Soil 4b: Limited Excavation, Off-Site Disposal and Low-Permeability Cover: $13 M
- Alternative Soil 5: Extensive Excavation and Off-Site Disposal $134.5 M
- Alternative Soil 6a: Limited Excavation, On-Site Consolidation and Soil Cover: $6.1 M
- Alternative Soil 6b: Limited Excavation, On-Site Consolidation and Low-Permeability Cover: $6.8 M

The greatest amount of uncertainty in these cost estimates is associated with Alternative Soil 5. While this alternative is already estimated to have the highest cost, these costs could significantly increase. The alternative includes the offsite disposal of an extremely large quantity of soil. Increasing fuel prices would significantly increase transportation costs for offsite disposal. Another area of uncertainty that would affect Alternatives Soil 4a, 4b, 5, 6a, and 6b is the amount of subsurface structures that are encountered. This would affect the amount soils actually removed, the area backfilled and the final grading plan. The amount of backfilling necessary to achieve the proper final grading under Alternatives Soil 4a, 4b, 6a and 6b is dependent on the location and degree of structures encountered. Lastly, the volume of sediment that would need to be removed during installation of the riprap toe (as part of riverbank restoration) is uncertain. This uncertainty would impact all of the soil alternatives except Alternatives Soil -1 (no action).

State Agency Acceptance

The State of Ohio has concurred with the remedies selected in this ROD, and the State's concurrence letter is included as Appendix C of this ROD. Ohio EPA has been involved with this Site in all of its phases of work, including review of all Tar Plant RI/FS documents and has provided comments and technical support to U.S. EPA throughout the project.

Community Acceptance

Per NCP requirements, U.S. EPA offered the public an opportunity for a public meeting and received no requests. Consequently, no public meeting was held to discuss the Tar Plant RI/FS and Proposed Plan. The public comments that were received are presented in the Responsiveness Summary, Appendix A, of this ROD.

10.2 Air Alternatives

The following two air alternatives were evaluated:

- Alternative Air-1: No Further Action
- Alternative Air-2: Institutional Controls

Overall Protection of Human Health and the Environment

Alternative Air 2 is protective of human health and the environment. Alternative Air 1 (No Further Action) is not protective.

Compliance with ARARs

Alternative Air 2 complies with ARARs. Alternative Air 1 (No Further Action) does not comply with ARARs since no action is proposed.

Long-Term Effectiveness and Permanence

Alternative Air 2 would provide long-term, permanent control of risk through use restrictions requiring health and safety measures for construction (i.e., excavation) workers and engineering controls for potential future buildings. Alternative Air 1 would not provide for long-term or permanent protection.

Reduction of Toxicity, Mobility, and Volume through Treatment

Neither alternative provides a reduction of risks through treatment.

Short-Term Effectiveness

Honeywell owns the property and is able to institute the necessary use restrictions. As a result, Alternative Air 2 would provide short-term effectiveness in addressing potential risks associated with indoor air and worker exposure to soil vapors. No adverse effects would result from this alternative. Alternative Air 1 would not provide any short-term value or create any additional short-term risks.

Implementability

Since Honeywell owns the property, the necessary use restrictions, required in Alternative Air 2, are easily instituted. Alternative Air-1 is easily implemented also, since it does not require any actions.

Cost

The following are the present worth estimates for the alternatives:

- Alternative Air-1: No Further Action: $0
- Alternative Air-2: Institutional Controls: $75,000

The costs for engineering controls, if necessary for future buildings, are not included in the cost of Alternative Air-2.

State Agency Acceptance

The State of Ohio has concurred with the remedy selected in this ROD, and the State's concurrence letter is included as Appendix C of this ROD. Ohio EPA has been involved with this Site in all of its phases of work, including review of all Tar Plant RI/FS documents and has provided comments and technical support to U.S. EPA throughout the project.

Community Acceptance

Per NCP requirements, U.S. EPA offered the public an opportunity for a public meeting and received no requests. Consequently, no public meeting was held to discuss the RI/FS and Proposed Plan for the Tar Plant. The public comments that were received are presented in the Responsiveness Summary, Appendix A, of this ROD.

10.3 Sediment Alternatives

The following five sediment alternatives were evaluated:

- Alternative Sediment 1: No Further Action
- Alternative Sediment 2: Monitored Natural Recovery
- Alternative Sediment 3: In-Situ Capping
- Alternative Sediment 4: Dredging and Off-Site Disposal
- Alternative Sediment 5: Combination of Dredging and In-Situ Capping

Overall Protection of Human Health and the Environment

Alternatives 3, 4, and 5 are all protective of human health and the environment. Due to a lack of available data, it is uncertain whether Alternative Sediment-2 (Monitored Natural Recovery) is protective. Alternative Sediment-1 (No Further Action) is not protective.

Compliance with ARARs

Chemical-specific ARARS are not established. Alternatives 2,3, 4, and 5 all comply with location and action-specific ARARs. ARARS are not applicable to Alternative 1.

Long-Term Effectiveness and Permanence

Alternatives 3, 4, and 5 would provide long-term effectiveness through proven technologies and potential implementation of a residual management plan. Monitored Natural Recovery (Alternative Sediment-2) may also provide long-term effectiveness but insufficient information exists to evaluate this. Alternative Sediment-1 would not provide for long-term or permanent protection.

Reduction of Toxicity, Mobility, and Volume through Treatment

None of the alternatives provide reduction of toxicity, mobility and volume through treatment.

Short-Term Effectiveness

Alternative Sediment 3 quickly reduces the risks by providing an immediate clean substrate for the benthic environment. Because resuspension may occur and residuals may remain under Alternative Sediment 4, risks are not immediately reduced during dredging. Both alternatives would require protective measures to minimize adverse impacts to the aquatic environment during implementation. Alternative Sediment 5 includes capping and dredging in areas to be determined after additional data collection and design. The same short-term benefits and potential adverse impacts over the short-term apply as with Alternative Sediment 3 and 4. Alternative Sediment 2 relies on natural recovery. While the rate of recovery is unknown, at present, this alternative does not have any short-term adverse impacts on the aquatic environment. Alternative Sediment 1 does not provide any short-term value, but does not result in short-term adverse impacts.

Implementability

Alternative Sediment 1 is the most easily implemented because it does not involve any actions. Alternative Sediment 2 involves monitoring of natural recovery, which is easily implemented. Alternative 3 can be implemented far more easily than alternative Sediment 4 since capping does not require a large dewatering area and subsequent treatment of dewatering fluids, as does dredging. In addition, there are no contaminated sediment transportation and disposal issues with capping. Alternative Sediment 5 has the same implementation advantages and disadvantages as Alternative Sediment 3 and 4.

Cost

The following are the present worth estimates for the alternatives:

- Alternative Sediment 1: No Further Action - $0
- Alternative Sediment 2: Monitored Natural Recovery - $0.7 M to $1.0 M
- Alternative Sediment 3: In-Situ Capping - $1.8 M to 3.4 M
- Alternative Sediment 4: Dredging and Off-Site Disposal - $6.8 M to 9.9 M
- Alternative Sediment 5: Combination of Dredging and In-Situ Capping - $2.8 to $4.5M

Cost estimates for Alternatives 3, 4, and 5 are uncertain because there may be some locations with some contaminated sediment at depth ,which were not found during the RI. Sediment sampling during the RI found some areas with fine-grained sediment and some areas with cobble or hardpan. Pre-design studies will require more sampling, if needed, to ascertain the volume of contaminated sediment.

State Agency Acceptance
The State of Ohio has concurred with the remedy selected in this ROD, and the State's concurrence letter is included as Appendix C of this ROD. Ohio EPA has been involved with this Site in all of its phases of work, including review of all Tar Plant RI/FS documents and has provided comments and technical support to U.S. EPA throughout the project.

Community Acceptance
Per NCP requirements, U.S. EPA offered the public an opportunity for a public meeting and received no requests. Consequently, no public meeting was held to discuss the RI/FS or the Proposed Plan. The public comments that were received are presented in the Responsiveness Summary, Appendix A, of this ROD.

11.0 Principal Threat Wastes

The NCP establishes an expectation that U.S. EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Identifying principal threat wastes combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile, which generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. Conversely, nonprincipal threat wastes are those source materials that generally can be reliably contained and that would present only a low risk in the event of exposure. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

The contaminated soils, soil vapor and sediments at the Tar Plant are not considered to be principal threat wastes because they are not source materials that act as a reservoir for migration of contamination to groundwater, surface water or air. The DNAPL and other highly toxic and highly mobile contaminants in groundwater, which are principal threat wastes for the Site, are addressed via the RODs and enforcement documents for OU1 and OU2.

12.0 Selected Remedy

12.1 Identification of the Selected Remedy and the Rationale for its Selection

The selected soil remedy is Alternative 3b, Low-Permeability Soil Cover. The selected air remedy is Alternative 2, Institutional Controls. The selected remedy for sediments is Alternative 5, Combination of Dredging and In-Situ Capping. These alternatives represent the best balance of overall protectiveness, compliance with ARARs, long-term effectiveness and permanence, costs, and other criteria, including state and community acceptance.

12.2 Description of the Selected Remedy

Following is a description of each component of the selected remedies. Although U.S. EPA does not expect significant changes to these remedies, it may change somewhat as a result of the remedial design (RD) and construction processes. Any changes to the remedies described in this ROD would be documented using a technical memorandum in the Administrative Record, an Explanation of Significant Differences (ESD), or a ROD Amendment, as appropriate and consistent with the applicable regulations and in consideration of Agency guidance.

The selected remedies are:

- Soil: Alternative Soil 3b: Low-Permeability Cover
- Air: Alternative Air 2: Institutional Controls
- Sediment: Alternative Sediment 5: Combination of Dredging and Offsite Disposal and In-Situ Capping

Section 9 of this ROD presented a brief description of all the alternatives. A more detailed description and discussion of the selected remedies is provided here. Specific details regarding how the remedy will be implemented will be determined during the remedial design phase.

12.2.1 Soil Remedy Alternative Soil-3b: Low-Permeability Cover

This alternative includes the installation of a low-permeability cover system over portions of the Tar Plant with soil contamination. Figure 8 denotes the area for the most restrictive exposure pathway (i.e., future commercial/industrial outdoor worker) at the 10^{-6} risk level where the low-permeability cover would be installed. Areas identified as having a potential ecological risk would also be covered. As shown on Figure 8, the covered area includes the majority of the area on the main parcel and river parcel. The low-permeability cover system would create a physical barrier to direct contact with contaminated soils by human and ecological receptors. Institutional controls will be implemented, and site inspections conducted periodically to ensure the soil cover remains intact and that institutional controls are being enforced. Results of the inspections would be reported in the five-year review reports. The following key components are described further:

- Pre-Design Studies;
- Installation of a Low-Permeability Cover on the Main Parcel;
- Installation of a Soil Cover on the River Parcel;
- Institutional Controls and Inspections; and
- Five-Year Reviews

<u>Pre-Design Studies</u>
Pre-design studies include a topographic survey of the main parcel and river parcel, and geotechnical study for stream bank restoration.

Installation of Low-Permeability Cover

Because of the differences in construction on the main parcel and the river parcel, this section of the alternative has been split into the main parcel and the river parcel.

Main Parcel – The main parcel consists of 16.1 acres. Existing information indicates that the shallow (i.e., zero to five feet depth) and deep (i.e., below five feet depth) soil is contaminated with PAHs. Benzene, toluene, ethylbenzene, and xylene compounds are found in shallow soils over the majority of the parcel and found in deep soils only on the south half. Arsenic is also found in shallow and deep soils with no apparent pattern. Alternative Soil-3b includes grading of the current surface, followed by the installation of low-permeability cover to prevent infiltration of precipitation, consistent with the Ohio EPA municipal solid waste landfills requirements. In developing this alternative for evaluation purpose, it is assumed that the cover system would consist of a geosynthetic clay liner (GCL) with a 40 mil flexible membrane liner (FML), and a drainage net which would then be covered by 12-inch layer of clean sand, a 12-inch layer of clean fill, followed by 6-inches of topsoil and seeding. During the design phase, Honeywell may evaluate and present to U.S. EPA and Ohio EPA options for alternative cover systems that meet the infiltration goals of the Ohio EPA municipal solid waste landfill regulations and are compatible with site redevelopment.

As part of installing the cover system, some soils will be excavated and either used on-site as fill or disposed off-site as non-hazardous waste (this is based on the waste characterization data from the existing investigation derived waste). This will include the removal of soil along the property perimeter to allow proper grading to the adjacent properties (an estimated 3.5-foot perimeter cut) and fill beneath the cap to acquire an appropriate slope. Materials showing visual evidence of free flowing tar will be segregated and disposed off-site in a licensed facility. The existing above-ground piping will be replaced with underground piping and the above ground structures (i.e., metal shed, retaining walls, and sumps) and debris piles will be removed. Installation of a low-permeability cover, as described above, will result in a some change in the grade elevations (i.e., it is estimated that an approximate 5.5-foot increase in elevation would occur on the south end of the main parcel, and that an approximate 11-foot elevation increase would occur on the north end of the main parcel). Final elevations would be determined during design and would account for making the property attractive for redevelopment to the extent practical. This alternative also requires demolition of the existing engineering building, relocation of the existing underground utilities closer to the new grade, relocation of the utility poles, and relocation of the electrical substation on the southern main parcel. Modification of the existing monitoring wells may also be necessary to allow for future monitoring/recovery of groundwater and/or DNAPL.

River Parcel – A low-permeability cover would not be installed on the river parcel due to concerns regarding hydraulic instability caused by hydrostatic pressure differences between the groundwater and surface water. Such pressure differences could cause the low-permeability cover to fail. Additionally, lack of good adhesion between the GCL/FML and the soil could cause the low-permeability cover to slide down the embankment during a significant rainfall and/or flood event. Further still, hazardous work conditions may be created in the event of rain or flood during the installation of the GLC/FML layer.

Consequently, a soil cover will be installed on the River Parcel, as described in the draft FS for Alternative Soil – 3a: Soil Cover.

The river parcel consists of 4.8-acres along the Ohio River and lies within the 100 year flood plain. It is bordered by a very active railroad line that, according to railroad officials, may be expanded. From the railroad right-of-way, the parcel slopes steeply to the Ohio River. Existing information indicates that high PAHs were identified only in shallow soils north of the elevated pipeline leading from the dock to the former plant. Alternative Soil 3b includes clearing and grubbing 4-acres of the River Parcel; grading to achieve the necessary slope along the river bank; installation of a geotextile fabric; soil cover consisting of 6-inches of top soil and a minimum of 18-inches of clean fill to prevent direct contact with or ingestion of affected soils by humans and to protect potential ecological receptors; and restoration of the river bank. Native plants will be planted to anchor the embankment while improving riverbank aesthetics.

The length of the river bank where the soil cover would be installed will be restored and stabilized by installing a geotextile and then installing dump rock or riprap onto the bank. The size, the depth, and the elevation on the bank would be dictated by the river hydrology, but for the purposes of this study, it was assumed that Class A size rock, 3 feet deep, will be installed to the top of the bank. As part of installing the rock toe, it may be necessary to remove sediment along the bank. Highly contaminated sediment will be disposed at a permitted offsite facility. At the normal pool elevation, the dump rock would be mixed with soil and live posts would be inserted between the rocks. These posts would be willow and cottonwood and will grow to trees. Above the dump rock toe, the bank will be shaped to the necessary slope, seeded with native grasses and a temporary seed matrix, mulched, and covered with a 900 gram woven coir blanket. The entire bank of the river will be planted with native shrubs and trees supplied in 2-gallon containers. A swale will be installed at the top of the bank to prevent surface flow from running onto the bank. At four locations, flow will be concentrated and run down the bank on a dumprock swale. The premise of this alternative is that it is environmentally friendly and self sustaining. The vegetation is self renewing and the banks increase in strength over time. Burrowing wildlife is not a concern in the long-term because the banks are self repairing as they would be in nature. Other options (e.g., riprap along the entire face of the bank and/or an interlocking concrete and cable system) were considered but are not recommended since they are less consistent with the environment and not as pleasing aesthetically.

<u>Institutional Controls and Inspections</u>

Restrictive covenants that run with the land and that bind all future owners and users of the property will be executed and recorded in the real property record. Such covenants will prohibit residential use of the property, prohibit the use of onsite groundwater, prohibit compromising or otherwise degrading the cover systems, and require that U.S. EPA approved monitoring or institutional controls be in place prior to the undertaking of any construction work on the property or the occupancy of any structures to be built on the property. U.S. EPA and Ohio EPA will be express third-party beneficiaries to the restrictive covenants with the right to enforce the restrictive covenants. The restrictive covenant will include language that approval of U.S. EPA and Ohio EPA would be required as a condition precedent to any modifications of the restrictive covenants.

An Institutional Control Implementation and Assurance Plan (ICAIP) will be prepared for the Site. The ICAIP will include a checklist of elements to be assessed during regularly scheduled onsite inspections to verify compliance with all institutional controls. The institutional control inspections will be performed once per year.

__Five-Year Reviews__

Pursuant to CERCLA 121(c), any remedial action that results in contaminants remaining on-site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative is a statutory review.

The five-year review for this alternative will consist of, at a minimum, conducting a Site visit and interviews, evaluating environmental monitoring data, institutional control inspection reports, and reviewing the ROD requirements and ARARs. The assumptions of the risk assessment will be reviewed for appropriateness and upon consideration of available monitoring data, ARARs, institutional control inspection reports, and results of the Site visit and interviews, a conclusion would be made concerning the protectiveness of the remedy. The review will assess/recommend whether ICs should be continued. If contaminant concentrations remain above the cancer risk and non-cancer hazard index in excess of NCP and Ohio EPA risk management criteria, the data and inspections reports would be evaluated to confirm that the alternative continues to be protective of human health and the environment. The five-year reviews would also consider the benefits of new or emerging technologies that may improve remedial performance. Two five-year reviews have already been conducted for the Site (because the remedies for OU1 and OU2 have already been constructed and implemented). The next five-year review is required to be completed by September 13, 2009 and will include OU3.

12.2.2 Air Remedy Alternative Air-2: Institutional Controls

Alternative Air 2 relies on institutional controls, and five-year reviews to control potential human-health risks from exposure to vapor. This alternative consists of the following key components:

- Institutional Control and Inspections; and
- Five-Year Reviews.

__Institutional Controls and Inspections__

This alternative includes institutional controls in the form of land-use restrictions requiring that land use remains industrial/commercial. Additional restrictions will require that future buildings include measures (e.g., physical barriers, venting, monitoring) to protect indoor workers and that health and safety procedures be established to protect outdoor workers during any excavation or grading activities. Restrictive covenants will be properly recorded in the property records.

An ICAIP will be prepared for the Site. The ICAIP will detail the restrictive covenants to be recorded. The ICAIP will include (at a minimum) a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the on-site inspection will include inspecting physical barriers, such as fencing, to insure its integrity; verifying warning signs are in place and intact; and insuring that no structure or pavement has been disturbed or removed. The institutional control inspections will be performed once per year.

Five-Year Site Reviews

Pursuant to CERCLA 121(c), any remedial action that results in contaminants remaining on-site at concentrations above those allowing unlimited exposure and unrestricted use must be reviewed at least once every five years. During five-year reviews, an assessment is made as to whether the implemented remedy continues to be protective of human health and the environment, or whether the implementation of additional remedial action is appropriate. The five-year review for this alternative is a statutory review.

The five-year review for this alternative will consist of, at a minimum, conducting a Site visit and interviews, evaluating environmental monitoring data, institutional control inspection reports, and reviewing the ROD requirements and ARARs. The assumptions of the risk assessment will be reviewed for appropriateness and upon consideration of available monitoring data, ARARs, institutional control inspection reports, and results of the Site visit and interviews, a conclusion would be made concerning the protectiveness of the remedy. The review will assess/recommend whether ICs should be continued. If contaminant concentrations remain above the cancer risk and non-cancer hazard index in excess of NCP and Ohio EPA risk management criteria, the data and inspections reports would be evaluated to confirm that the alternative continues to be protective of human health and the environment. The five-year reviews would also consider the benefits of new or emerging technologies that may improve remedial performance. Two five-year reviews have already been conducted for the Site (because the remedies for OU1 and OU2 have already been constructed and implemented). The next five-year review is required to be completed by September 13, 2009 and will include OU3.

12.2.3 Sediment Remedy Alternative Sediment – 5: Combination of Dredging and In-Situ Capping

This alternative consists of implementing both Alternative Sediment – 3: In-Situ Capping and Alternative Sediment – 4: Dredging and Offsite Disposal. Combining capping with dredging will limit the volume of material that will need dewatering and limit the volume disposed in the landfill, which affects landfill capacity. This alternative may include all of the procedures, controls, and residual management discussed in Alternative Sediment - 3 and 4. Dredge areas and cap design will take into account navigational suitability, rocky or gravelly bottoms precluding successful dredging, ice flow scour and catastrophic flooding impacts.

Pre-Design Studies

Additional data will be collected to determine the vertical and horizontal profiles of the sediment contamination and the most current information on river hydraulics. The additional data may include: additional biological/toxicological testing to refine the area of contamination; river flow velocities; grain size distribution; sediment shear strength; and hydrographic and side-scan sonar surveying.

Dredging

Dredging consists of the removal of contaminated sediment from the river bottom, dewatering the sediment, followed by transportation and off-site disposal. Because sampling during the RI found that in many locations, there was no fine-grained sediment (there was hardpan or cobbles), there may be areas within the zone of concern that may have more sediment at depth – depositional zones not previously encountered. This ROD assumes that dredging would be completed to either the depth of gravel/cobbles or bedrock. The extent of dredging would be based on additional data collection and evaluation.

Sediment will be removed using dredging techniques appropriate to the site conditions. The work area may be bordered by turbidity curtains, which are made of materials permeable to water but prevent migration of suspended solids. These are installed vertically in the water by anchoring to the bottom of the river. If the river flow velocities are too great to use turbidity curtains, a coffer dam may be considered as an alternative. Turbidity levels in the river would be measured and compared with PRGs during dredging to ensure suspended solids are not migrating downstream.

Dewatering, Transfer, and Disposal

During design, methods to dewater excavated sediment will be evaluated. This will include evaluating the potential use of geotubes located in a containment area constructed on the main parcel of the Tar Plant. Water generated during the dewatering process may be collected and treated by the existing water treatment system located on the CPLA operable unit. Due to the potential limited capacity of the treatment system, water may need to be stored in above-ground tanks or frac tanks until treatment.

Following dewatering, the sediment will be transported off -site to an approved landfill and disposed. Sediment transportation to the landfill will be by truck. Waste characterization, profiling, and landfill approval will be completed during the pre-design and design phases of the sediment investigation.

Prior to sediment transportation to the landfill for disposal, the sediment may need to be stabilized. Stabilization involves mixing the sediment with lime or cement kiln dust so that it passes the paint-filter test. A paint-filter test is used to determine if free liquids are present, which would render the waste unacceptable for landfill disposal.

Post-Dredging Sampling and Residual Management

Because of the practical limitations of removing sediment in a dynamic river environment, some residual contaminated sediment may remain. Following the completion of dredging, verification sample collection will be performed to assess whether residuals are present. If verification samples can be collected and the results indicate that PRGs are still exceeded, a residual management plan can be implemented. One example of such a plan would be the placement of a layer of sand or cobbles or geotextile on top of the residuals.

Installation of In-Situ Cap

In-situ capping isolates the contaminated sediment from the benthic and aquatic ecosystems. The contaminated sediment exceeding clean up goals will be covered with either earthen materials (such as, sand, or gravel, and/or cobbles), engineered materials (such as, geosynthetics or marine mattresses), or a combination of these materials. Design and material selection depends on the nature of the contamination, the physical and hydraulic characteristics of the waterway (including scour), long-term plans for the area (i.e., development and maintenance activities), and permitting requirements. One cap design consideration consists of riprap that would be installed as part of the riverbank restoration (see subsection 4.2 of the *April 2007 Feasibility Study*) extending down into the river to act as a portion of the cap and/or as armor protecting the cap.

Institutional Controls and Inspections
Institutional controls will be implemented to prevent activities that could damage the cap. One such control may include a prohibition of dredging in the area of the cap.

An ICAIP will be prepared for the Site. The ICAIP will detail the restrictive covenants to be recorded. The ICAIP will include (at a minimum) a checklist of elements to be assessed during regularly scheduled onsite inspections. Elements of the onsite inspection will include inspecting physical barriers, such as fencing, to insure its integrity; verifying warning signs are in place and intact; and insuring that no structure or pavement has been disturbed or removed. The institutional control inspections will be performed once per year.

Five-Year Site Reviews
In accordance with CERCLA 121(c), the integrity and effectiveness of the cap will be monitored through five year reviews and through procedures established in the Operations and Maintenance Plan (e.g., cap integrity may be required to be checked during or after storm events). Monitoring may consist of sediment sampling and analysis and visual inspections by divers. The review would include evaluation of the ROD requirements and ARARs. The assumptions of risk assessment work will be reviewed for appropriateness and upon consideration of available monitoring data. The review will include a conclusion concerning the protectiveness of the remedy. The Site reviews would consider benefits of new or emerging technologies that may improve remedial performance. The next five-year review for the Site is required by September 13, 2009, as discussed previously.

12.3 Summary of the Estimated Remedy Costs

Appendix B includes details of the estimated costs to implement and construct the selected remedial actions. The estimated total cost to implement and construct the selected remedial actions presented in this ROD is $10,175,000. This is based on estimates of $5.6M for the soil remedy, $4.5M for the sediment remedy and $75,000 for the air remedy. The information in this cost estimate is based on the best available information regarding the anticipated scope of the selected remedial actions.

Changes in the cost elements are likely to occur as a result of new information and data collected during the design of the remedial actions. Major changes may be documented in the form of a technical memorandum in the Administrative Record file, an ESD, or a ROD amendment. This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

12.4 Expected Outcomes of the Selected Remedy

Implementation of the selected remedies will reduce the human health risks and the risks to aquatic organisms in the Ohio River adjacent to the Site over time. The selected remedies, in conjunction with the remedies for OU1, GDA and OU2, CPLA, will achieve the RAOs set forth earlier in this ROD. The selected remedies are protective of human health and the environment. The outcome of the remedies is not expected to change the land use at the Tar Plant as ICs will require the Tar Plant to remain industrial/commercial.

Table 30 presents the expected cleanup levels for the COCs that are driving the need for remedial action at the Tar Plant.

13.0 Statutory Determinations

Under CERCLA §121 and the NCP §300.430(f)(5)(ii), U.S. EPA must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element and a bias against offsite disposal of untreated wastes. The following sections discuss how the selected remedial alternatives meet these statutory requirements.

13.1 Protection of Human Health and the Environment

The selected remedies for soil, air, and sediment at the Tar Plant will be protective of human health and the environment. Exposure to COCs in surface soils will be addressed and eliminated through the installation of the low-permeability cap over all soils at the site posing excess cancer lifetime risk greater than 1×10^{-6}. Exposure to subsurface soils during any future excavation, construction or grading activities will be reduced or eliminated by following the health and safety requirements that will be prescribed in the site-specific health and safety plans as required by institutional controls. Installation of vapor mitigation systems in any buildings built on-site in the future will address vapor intrusion and cancer risks to below safe levels.

Dredging and off-site disposal of contaminated sediments will remove a mass of contaminated sediment from the Ohio River. Capping the remaining contaminated sediments will eliminate the exposure of benthic invertebrates to the remaining (if any) contaminated sediments.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements

The NCP §300.430(f)(5)(ii)(B) and (C) require that a ROD describe the federal and state ARARs that the elected Remedy will attain or provide justification for any waivers. ARARs include substantive provisions of any promulgated Federal or more stringent State environmental standards, requirements, criteria, or limitations that are determined to be legally applicable or relevant and appropriate for a CERCLA site or action. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Relevant and appropriate requirements are requirements that, while not legally "applicable" to circumstances at a particular CERCLA site, address problems or situations sufficiently similar to those encountered at the site that their use is relevant and appropriate.

The selected remedy will comply with ARARs. The ARARs are presented below and in more detail in Tables 27 - 29.

Chemical, location, and action-specific ARARs include the following:

- Clean Air Act applicable to emissions from stationary sources;
- Hazardous Waste Regulations (40 CFR 261) for waste disposal;
- U.S. Department of Transportation (DOT) Regulations for transportation of hazardous waste (49 CFR 171, 172 and 180);
- Ohio EPA Voluntary Action Program – Generic Direct Contact Soil Standards for Commercial/Industrial Property;
- Floodplain Management Executive Order 11988 [40 CFR Part 6, Appendix A];
- Ohio Floodplain Regulation Criteria, Ohio Revised Code Section 1521;
- Executive Order 11990, Protection of Wetlands [40 CFR part 6, Appendix A];
- Water Quality Standards, Ohio Administrative Code 3745-1;
- Fish and Wildlife Coordination Act [15 USC 661 et seq.];
- Clean Water Act §404.33 CFR parts 320-330 and CFR part 230;
- Rivers and Harbors Act, Section 10 33 CFR parts 320 to 323;
- Resource Conservation and Recovery Act, Subtitle D 40 CFR 258; and
- Ohio Hazardous Waste Management Standards OAC Title 3745.

13.3 Cost Effectiveness

The selected remedies are cost effective because the remedies' costs are proportional to its overall effectiveness (see 40 CFR §300.430(f)(l)(ii)(D)). This determination was made by evaluating the overall effectiveness of those alternatives that satisfied the threshold criteria (i.e., that are protective of human health and the environment and comply with all federal and any more stringent state ARARs, or as appropriate, waive ARARs). For details on this evaluation, see the April 26 FS and the June 15 FS Addendum, both of which are in the Administrative Record.

Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). The overall effectiveness of each alternative was then compared to each alternative's costs to determine cost effectiveness. The relationship of the overall effectiveness of these remedial alternatives was determined to be proportional to their costs and hence represent reasonable value for the money to be spent.

13.4 Utilization of Permanent Solutions to the Maximum Extent Practicable

U.S. EPA has determined that the selected remedies represent the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the Tar Plant. Of those alternatives that are protective of human health and the environment and comply with ARARs, U.S. EPA has determined that the selected remedies provide the best balance of tradeoffs in terms of the five balancing criteria, bias against off-site treatment and disposal, and considering state and community acceptance.

The selected remedies provide the highest degree of long-term protectiveness and represent a permanent solution for the Tar Plant. None of the alternatives reduce the toxicity, mobility or volume through treatment, yet the selected remedies do not present short-term risks different from the other alternatives. There are no special implementability issues that set the selected remedies apart from any of the other alternatives evaluated. The State of Ohio views the selected remedies as the only acceptable alternative. Overall, the selected remedies afford the best balance of tradeoffs when compared to the other alternatives.

13.5 Preference for Treatment as a Principal Element

U.S. EPA believes that the selected remedies are protective of human health and the environment and utilize permanent solutions to the maximum extent practicable, since there are no wastes identified as principal threats in the soil, surface water, sediment, soil vapor and ambient air.

13.6 Five-Year Review Requirements

Because this remedy will result in hazardous substances, pollutants or contaminants remaining on-site above levels that allow for unlimited use and unrestricted exposure, a statutory review, known as the five-year review, is required for the entire Site. Five-year reviews are required every five years from initiation of construction of the remedies. The five-year review for this operable unit, however, will be conducted in accordance with the schedule for the site-wide five year review. The next five-year review for the Site is required to be completed by September 13, 2009. The objective of these five-year reviews will be to confirm that the remedies are, or will be, protective of human health and the environment. If the selected remedies are found to be unprotective, then corrective actions to bring the remedies to a protective level will be taken.

14.0 Documentation of Significant Changes from Preferred Alternative of Proposed Plan

U.S. EPA has not made any significant changes to the remedies, as originally identified in the Proposed Plan. The Proposed Plan was released for public comment on July 13, 2007. The public comment period for the Proposed Plan was held from July 16 through August 14, 2007. U.S. EPA offered the public an opportunity for a public meeting, yet none was requested. U.S. EPA reviewed and responded to written and verbal comments submitted during the public comment period in the Responsiveness Summary (Appendix A).

Appendix A: Responsiveness Summary

RESPONSIVENESS SUMMARY

Allied Chemical and Ironton Coke Site
Operable Unit 3 (Tar Plant)
Ironton, Ohio

Sections 113(k)(2)(B)(iv) and 117(b) of CERCLA (42 U.S.C. §§ 9613(k)(2)(B)(iv) and 9617(b)) require U.S. EPA to respond "...to each of the significant comments, criticisms, and new data submitted in written or oral presentations" on a proposed plan for a remedial action. This Responsiveness Summary addresses those concerns expressed by the public, potentially responsible parties (PRPs), and governmental bodies in written and oral comments we've received regarding the proposed remedy for the site.

U.S. EPA has established information repositories for the Tar Plant at the following locations:

- U.S. EPA - Region 5, Records Center, 77 W. Jackson Blvd., Chicago, IL 60604
- Briggs Lawrence County Public Library, 321 South Fourth Street, Ironton, Ohio

The Administrative Record containing all information we used to select the cleanup remedy for the Tar Plant is also available to the public at these locations.

Background

On July 15, 2007, U.S. EPA issued a notice in the Ironton Tribune, that the Proposed Plan for clean up of the Tar Plant was available for public review and comment. The comment period set in the notice was from July 16 – August 14, 2007. As part of the public comment period, U.S. EPA accepted written, e-mailed, or faxed comments.

Also in the Tribune notice U.S. EPA gave the public an opportunity to request a public meeting. U.S. EPA received no requests for a meeting during the public comment period, so no public meeting was held.

At the end of the public comment period, U.S. EPA received 1 oral comment concerning the proposed plan from a conference call held with local elected officials. U.S. EPA received 1 written (by letter) comment concerning the proposed plan during the comment period. The comments received during the public comment period and our responses to these comments are included in this Responsiveness Summary which is a part of the Record of Decision for the Allied Chemical and Ironton Coke Superfund Site, Operable Unit 3 (Tar Plant).

Written Comment

Pages 3, 4, 5 of the Proposed Plan state that the proposed cap would meet certain criteria set forth in Ohio regulations for solid waste disposal landfills. As Honeywell has discussed with both the United States Environmental Protection Agency and the Ohio Environmental Protection Agency, not all of the aspects associated with these regulations are appropriate. Examples of portions of the regulations that are not appropriate include the need for gas vents or a five percent slope. Honeywell respectfully requests that the Record of Decision permit flexibility in designing the cap to account for those aspects of the Ohio landfill cap regulations that are not appropriate for this Site.

U.S. EPA Response

We recognize that the Ohio regulations for impermeable solid waste landfill caps contain numerous design criteria not all of which may be appropriate for the Tar Plant because the cap here will not be covering a solid waste landfill. The specifics of the design of the cap will need to be addressed during the Remedial Design. The cap must be designed and constructed so as to provide an impermeable, structurally sound and permanent cover over the contaminated soils while controlling ponding, storm water run-off and erosion.

Oral Comment

Mayor Elam of the City of Ironton commented that the City is in the process of redeveloping another defunct industrial site and does not want to exchange one abandoned parcel for another.

U.S. EPA Response

The proposed cap is required to protect people from exposure to contaminated soils on site. It is possible, once the remedy is completed, for commercial, industrial or recreational redevelopment to occur. This has happened at many Superfund sites throughout the country. Any proposed redevelopment would need to be reviewed and approved by U.S. EPA to insure that the integrity of the cap is maintained and that human health and the environment would continue to be protected.

Responsiveness Summary
Supplement
November 8, 2007

Allied Chemical and Ironton Coke Site
Operable Unit 3 (Tar Plant)
Ironton, Ohio

1. Capping contaminated soil under a solid waste cap is not sufficiently protective of human health and the environment.

The remediation goals for the Tar Plant include protecting people and nonhuman receptors from exposure to contaminated soils. The United States Environmental Protection Agency (U.S. EPA) and the Ohio Environmental Protection Agency (Ohio EPA) believe that the selected solid waste cap is protective of human health and the environment as it would create a physical barrier between these receptors and contaminated soils. Ohio's solid waste rules are very prescriptive and provide for a low permeability barrier through various configurations of compacted clay, FML (flexible membrane liner), and GCL (geosynthetic clay layer). The low-permeability features of an Ohio solid waste cap (3745-27-08) provide further protection at the Tar Plant by reducing/eliminating infiltration of precipitation into soils, thus preventing leaching of contaminants to groundwater. In addition, institutional controls will be implemented, and inspections will be conducted periodically to ensure the cap remains intact and that institutional controls are being enforced. Results of the inspections will be reported in the five-year review reports.

Soil cover at the river parcel will reduce the human health risks and the risks to aquatic organisms in the Ohio River adjacent to the Allied Chemical and Ironton Coke site over time. The selected remedies, in conjunction with the remedies for operable unit one (OU1, the Goldcamp Disposal Area) and operable unit two (OU2, the Coke Plant/Lagoon Area) will achieve the remedial action objectives set forth for the entire Allied Chemical and Ironton Coke site prescribed in all of the Records of Decision and supplemental Record of Decision Amendments. The selected remedies are protective of human health and the environment.

2. Soils at the Tar Plant are contaminated with listed hazardous wastes (including spills that occurred after RCRA), so the proposed remedy will not meet ARAR's.

During its 55 years of operation, the 27-acre Tar Plant contained 124 above-ground storage tanks and process tanks varying in size from several hundred to 750,000 gallons, and numerous ancillary buildings used for storage, maintenance operations, and a laboratory. In addition, there were numerous material transfer lines located throughout the plant. Based on historical records and plant personnel interviews conducted by Honeywell, miscellaneous leaks and releases occurred in process, material handling, and storage areas that may have impacted surface soils (see page 21 through 24 of the Technical Letter Report, dated 22 October, 2003 for a list of Tar Plant Releases). The material transfer lines had leaked in the past and were therefore a suspected contaminant source. Due to the ubiquitous nature of these leaks and spills, it is impossible to distinguish soils that were contaminated with pure product from those contaminated with listed hazardous waste. Furthermore, the contaminated soils which are the subject of this response action do not themselves meet the definition of "waste" because they are not a "discarded material", 40 C.F.R. sec. 261.2. Even if the soils were a "waste" they would not be a hazardous waste because they are not listed as a hazardous waste, do not exhibit any of the characteristics of hazardous waste, and are not a mixture of a hazardous waste and a solid waste. Therefore, Ohio's hazardous waste and solid waste regulations are not "applicable" to the contaminated soils at this operable unit. We have determined that a number of the requirements of the Ohio solid waste regulations pertaining to landfills are both relevant and appropriate here, given the similarity of the type of materials and the risks to human health and the environment presented by the contaminated soils and wastes disposed of in solid waste landfills. The chosen remedy does meet ARARs.

3. This plan is not as protective as the plan to clean the New Boston Coke Plant (which has similar waste constituents and is being cleaned under state programs).

The New Boston Coke plant has not been subject to a Superfund remedial investigation and feasibility study (RI/FS) process as has the Allied Tar Plant in Ironton; there is no formal, sitewide cleanup plan for the New Boston Coke Plant. The remedy selected for the Tar Plant is protective of human health and the environment and is consistent with the National Contingency Plan.

4. Capping in-place reduces the potential for re-development of the site.

As stated on page 2 of the responsiveness summary, once the proposed cap is engineered and installed on the Tar Plant property, the site may be open for any type of commercial, industrial and recreational redevelopment. Placing a relatively level cap over the contaminated soils offers more opportunity for redevelopment than other alternatives that would create a more mounded cap or leave the site excavated and structurally unstable. Any proposed redevelopment will be reviewed by U.S. EPA and approved only if U.S. EPA is certain the integrity of the cap will be maintained.

5. Technologies are available and are feasible to remove the contaminants for permanent treatment or disposal off-site.

Prior to selecting the remedy, U.S. EPA, in consultation with Ohio EPA, conducted an analysis of all available technologies and alternatives including those that deal with excavation and off-site disposal. As stated in the ROD, based on the exposure criteria for organics, approximately 1.1 million cubic yards of contaminated soil would have required excavation. A large scale excavation of this area would be the most challenging of all alternatives, as it would require an excavation to a depth of 40 feet on the main parcel and 20 feet on the river parcel. This alternative would require disposal off-site of approximately 114,000 truckloads of contaminated material over a four-year period. The magnitude of this large scale excavation would cost approximately $135 million and would involve great logistical and administrative problems due to adverse impacts associated with increased truck traffic resulting in dust, noise and risk of accidents. This extensive excavation and offsite disposal would also result in the greatest amount of uncertainty to this remedial project as the excavation, transport and disposal costs could significantly increase. In addition, the site wide groundwater capture system would need to be shut down during the extended period of site excavation, allowing uncontrolled migration of contaminated groundwater. This alternative was evaluated in accordance with the nine criteria specified in the National Contingency Plan and compared against other alternatives. U.S. EPA, in consultation with Ohio EPA, performed this comparative analysis and selected the Ohio solid waste cap as the one which best met the balancing criteria.

6. Again, U.S. EPA appears to have taken the least expensive and least protective approach, to the detriment of the environment.

As required by the NCP, U.S. EPA, in consultation with Ohio EPA, conducted a detailed analysis of eight individual alternatives against each of the nine evaluation criteria (two threshold, five primary balancing, and two modifying criteria) and a comparative analysis focusing upon the relative performance of each alternative against those criteria. The solid waste cap alternative selected represents the best balance of overall protectiveness, compliance with ARARs, long-term effectiveness and permanence, costs, and other criteria, including state and community acceptance.

7. The chosen alternative at the adjacent GoldCamp Dump was a disaster to construct and, as with this remedy, does nothing to abate the DNAPL constituents in the groundwater.

In 1988, EPA issued a ROD for the Gold Camp Disposal Area (GDA) in order to isolate and contain the GDA as a future source of groundwater contamination. (OU1). Based on this ROD, a containment system was installed at the GDA, which included the construction of a slurry wall 2,000 feet in length and 90 feet deep all around the GDA and a cap over the GDA. Interior pumping wells were installed to maintain an inward hydraulic gradient and contain contamination inside the slurry wall; a network of seven wells located within the GDA containment wall which evaluates the GDA groundwater containment system. Similarly, a network of 25 wells outside the slurry wall both on and off the GDA site is monitored.

The chosen alternative at the GDA was difficult to implement but the remedy implemented is protective of human health and the environment as the threats have been addressed through the capping of the contaminated soil and maintaining inward hydraulic gradients within the GDA.

The second operable unit (OU2) comprehensively addressed site-wide groundwater contamination. Based on the second five-year review report, dated September 2004, all basic landfill components are in good condition and functioning as intended. The groundwater monitoring program continues to demonstrate the effectiveness of the slurry wall, confirms that the capture zone is generally controlled, confirms that site-wide groundwater is being contained on-site and that the DNAPL is being recovered and removed. Also, iron fouling of wells and a protracted capture zone was noticed in one sector due to lowering of pumping rates and higher than normal precipitation.

Additional focused investigations in the southeast and southwest portions of the site, which are not yet scheduled, will be used by U.S. EPA and Ohio EPA to evaluate and institute modifications to the groundwater remedy (e.g., targeted DNAPL recovery) in this area under the RODs for OUs 1 and 2. Honeywell is reviewing innovative technologies for Non-Aqueous Phase Substance (NAPS) remediation as they are required to do every two years. Honeywell is also working to get access from an adjacent property owner to install a new discharge pipeline, monitoring well and a new pumping well to replace an inactive pumping well. Since pumping operations began in late 1995, more than 870 million gallons of groundwater have been extracted from within the GDA and from all other areas of the site, including OU2 and the Tar Plant. Approximately 5,500 gallons of product has been removed through June 2007.

8. Groundwater is a special concern, being within the capture zone of the Coal Grove wellfield and immediately upstream from the City of Ironton's water intake.

Groundwater is being addressed under the remedy selected for OU2. With regard to the Coal Grove Well Field area, groundwater monitoring confirms that capture zone on the south of the site is generally controlled. However, some recent sample results have prompted additional focused investigations that are being conducted in accordance with the U.S. EPA and Ohio EPA approved Operations and Monitoring Plan. Honeywell is obtaining access to the adjacent property at the south end of the site to install additional monitoring and recovery wells to evaluate and institute any necessary modifications to the overall groundwater remedy being implemented under the OU2 remedy.

Appendix B: Cost Estimates

Of

Selected Alternatives

Alternative Soil-3B: Low-Permeability Cover (10^{-6} Outdoor Worker Risk Prevention)

CAPITAL AND FIXED COSTS

Item	Quantity	Units	Unit Cost	Present Worth
Design and Procurement Support				
Pre-Design Study	1	Lump Sum	$45,000	$45,000
Design, Specifications and Drawings	1	Lump Sum	$75,000	$75,000
Contract Procurement	1	Lump Sum	$10,000	$10,000
Construction Cost (Main Parcel)				
Mobilization, Demobilization, and Submittals	1	Lump Sum	$92,000	$92,000
SESC Controls and Maintenance	1	Lump Sum	$15,000	$15,000
Surficial Debris Removal and Disposal	500	Ton	$70	$35,000
Demolition and Disposal of Existing Structures	1	Lump Sum	$50,000	$50,000
Demolition and Disposal of Above Ground Piping	700	Linear Foot	$13	$9,100
Installation of Underground Piping	360	Linear Foot	$36	$12,960
Relocation of Substation	1	Lump Sum	$20,000	$20,000
Relocation of Underground Piping	1,000	Linear Foot	$36	$36,000
Stormwater Collection System	1	Lump Sum	$102,500	$102,500
Removal and Disposal of Free-Flowing Product in Soil	1	Lump Sum	$100,000	$100,000
Monitoring Well Abandonment 2-Inch Diameter	35	Each	$600	$21,000
Monitoring Well Abandonment 6-Inch to 12-Inch Diameter	3	Each	$4,000	$12,000
Raise Monitoring Wells 10 feet	24	Each	$540	$12,960
Monitoring Well Conversion To Flushmounts	24	Each	$600	$14,400
Perimeter Cut and On-Site Consolidation	24,500	Cubic Yard	$3	$73,500
Subgrade Grading	74,000	Square Yard	$2	$148,000
Geosynthetic Clay Liner Material and Installation	74,000	Square Yard	$5.85	$432,900
Flexible Membrane Liner Material and Installation	74,000	Square Yard	$6.03	$446,220
Underdrain Pipe Material and Installation	6,800	Linear Foot	$3.6	$24,480
Pump Stations	2	Each	$10,000	$20,000
"Low-Fine" Sand	24,600	Cubic Yard	$20	$492,000
Borrow Fill	24,600	Cubic Yard	$17	$418,200
Site Restoration	16	Acre	$33,400	$534,400
Fence	3,800	Linear Foot	$10	$38,000
Institutional Controls	1	Lump Sum	$10,000	$10,000
Construction Cost (Riverfront Parcel)				
Mobilization, Demobilization, and Submittals	1	Lump Sum	$25,000	$25,000
SESC Controls and Maintenance	1	Lump Sum	$50,000	$50,000
Clearing & Grubbing	3	Acre	$7,500	$22,500
Demolition of Save-All Structure	1	Lump Sum	$50,000	$50,000
Site Grading	13,800	Square Yard	$2	$27,600
Repair Outfall 002	1,000	Cubic Yard	$17	$17,000
Geotextile Material and Placement	8,300	Square Yard	$2	$16,600
18-inch Soil Cover Intallalation	8,300	Square Yard	$8.5	$70,550
Excavation, Transportation and Disposal of Soil For Riprap Toe	800	Cubic Yard	$120	$96,000
Mirafi Geotextile Under Riprap Toe	5,500	Square Yard	$12	$66,000
Riprap Toe	5,500	Cubic Yard	$84	$462,000
Coir Face Bio D Mat 90	8,300	Square Yard	$6	$49,800
Joint Planting - 2004 Stakes	2,004	Each	$6	$12,024
2-Gallon Trees and Shrubs - 1100 Plants	1,100	Each	$30	$33,000
Riprap Swales	4	Each	$10,000	$40,000
Site Restoration	3	Acre	$18,200	$54,600
Construction Oversight				
Construction Oversight	24	Week	$5,600	$134,400
Construction Management Support	24	Week	$2,000	$48,000
Construction Report	1	Lump Sum	$15,000	$15,000
CAPITAL AND FIXED COSTS SUBTOTAL				$4,590,700
Undeveloped Details/Contingency	10%			$459,070
TOTAL CAPITAL AND FIXED COSTS				$5,049,770

OPERATION AND MAINTENANCE COSTS

Item	Quantity	Unit	Annual Cost	Present Worth
Operation and Maintenance (Years 1 - 30)				
Cap Maintenance	1-30	Year	$25,000	$384,300
Reporting	1-30	Year	$3,000	$46,100
Instutitional Controls	1-30	Year	$2,400	$36,900
5 Year Review Reporting	1-30	5 Years	$15,000	$41,700
O&M PRESENT WORTH COSTS SUBTOTAL				$509,000
Undeveloped Details/Contingency	10%			$50,900
TOTAL PRESENT WORTH MONITORING COSTS				$559,900

TOTAL	**$5,609,670**

Notes
1. This opinion of probable cost was prepared using costs considered appropriate for typical operations. It is intended for use in comparing the relative cost of remedial alternatives. Actual costs may differ.
2. An interest rate of 5% was used in present worth calculations.

Alternative Air-2: Institutional Controls

CAPITAL AND FIXED COSTS

Item	Quantity	Units	Unit Cost	Present Worth
Engineering and Procurement Support				
Engineering and Implementation of Institutional Controls	1	Lump Sum	$15,000	$15,000
CAPITAL AND FIXED COSTS SUBTOTAL				$15,000
Undeveloped Details/Contingency	10%			$1,500
TOTAL CAPITAL AND FIXED COSTS				$16,500

OPERATION, MAINTENANCE, AND MONITORING COSTS

Item	Quantity	Unit	Unit Cost	Present Worth
Operation, Maintenance, and Monitoring (Years 1 - 30)				
Instututional Controls	1-30	Year	$750	$11,500
5 Year Review Reporting	1-30	5 Years	$15,000	$41,700
O&M PRESENT WORTH COSTS SUBTOTAL				$53,200
Undeveloped Details/Contingency	10%			$5,300
TOTAL PRESENT WORTH MONITORING COSTS				$58,500
TOTAL				**$75,000**

Notes:
1. This opinion of probable cost was prepared using costs considered appropriate for typical operations. It is intended for use in comparing the relative cost of remedial alternatives. Actual costs may differ.
2. An interest rate of 5% was used in present worth calculations

Prp. By:	MJM	Date: 4/13/07
Chk. By:	ESG	Date: 4/13/07

Alternative Sediment-5: Dredging and In Situ Capping

CAPITAL AND FIXED COSTS

Item	Quantity Low	Quantity High	Units	Unit Cost	Present Worth Low	Present Worth High
Design and Procurement Support						
Pre-Design Study	1	1	Lump Sum	$225,000	$225,000	$225,000
Design, Specifications and Drawings	1	1	Lump Sum	$100,000	$100,000	$100,000
Contract Procurement	1	1	Lump Sum	$10,000	$10,000	$10,000
Construction Cost (Dredging)						
Pre-dredge/Pre-cap Soundings	1	1	Lump Sum	$5,000	$5,000	$5,000
Project Submittals and Permitting	1	1	Lump Sum	$50,000	$50,000	$50,000
Pre-Construction Management/On-site Superintendent	1	1	Lump Sum	$80,000	$80,000	$80,000
Mobilization and set-up	1	1	Lump Sum	$180,000	$180,000	$180,000
Temporary Facilities	4	7	Month	$6,500	$26,000	$45,500
Establish Remediation Management Units	1	1	Lump Sum	$10,000	$10,000	$10,000
Turbidity Control/monitoring	1	1	Lump Sum	$250,000	$250,000	$250,000
Dredging and Handling of Contaminated Sediment	3,300	5100	Cubic Yard	$50	$165,000	$255,000
Periodic Soundings to Document Progress	5	5	Lump Sum	$2,500	$12,500	$12,500
Post-dredge Sounding	1	1	Lump Sum	$5,000	$5,000	$5,000
Sand Bedding/Capping Material (9" thick)	0	1	Lump Sum	$41,400	$0	$41,400
Placement of Sand Bedding/Capping	0	1756	Cubic Yard	$50	$0	$87,800
Stone-Filled Marine Mats (6" thick)	0	63200	Square Foot	$10	$0	$632,000
Geotextile	0	8214	Square Yard	$3	$0	$24,642
Placement of Stone-Filled Marine Mats	0	63200	Square Foot	$5	$0	$316,000
Diver Support During Mat Placement in Deep Water	0	25	Day	$10,000	$0	$250,000
Anchorage for Mats (Isolated Steep Slopes)	0	1	Lump Sum	$25,000	$0	$25,000
Rip Rap (Upstream and Downstream Ends of Mats)	0	1	Lump Sum	$10,000	$0	$10,000
Sand/Stone Capping Materials (2 ft thick)	1	0	Lump Sum	$132,990	$132,990	$0
Sand/Stone Capping Placement	3,900	0	Cubic Yard	$50	$195,000	$0
Site Restoration	1	1	Lump Sum	$10,000	$10,000	$10,000
Post-residual Cover/Post-cap Soundings	1	1	Lump Sum	$5,000	$5,000	$5,000
Post-construction Meeting	1	1	Lump Sum	$6,000	$6,000	$6,000
Post-construction Submittals and Progress Meetings	1	1	Lump Sum	$50,000	$50,000	$50,000
Demobilization	1	1	Lump Sum	$150,000	$150,000	$150,000
Construction Cost (Dewatering and Disposal)						
Geotube staging area construction	1	1	Lump Sum	$230,000	$230,000	$230,000
Geotubes	300	1200	Linear Foot	$28	$8,400	$33,600
Piping/water storage/pumping	1	1	Lump Sum	$10,000	$10,000	$10,000
Site Restoration	1	1	Lump Sum	$20,000	$20,000	$20,000
Sediment Transportation	1,700	4000	Ton	$42	$71,400	$168,000
Sediment Disposal	1,700	4000	Ton	$28	$47,600	$112,000
Debris Removal and Stockpiling	500	500	Cubic Yard	$42	$21,000	$21,000
Debris Disposal	750	750	Ton	$55	$41,250	$41,250
Construction Oversight						
Construction Oversight	13	26	Week	$5,600	$72,800	$145,600
Construction Management Support	13	26	Week	$2,000	$26,000	$52,000
Construction Report	1	1	Lump Sum	$15,000	$15,000	$15,000
CAPITAL AND FIXED COSTS SUBTOTAL					$2,230,940	$3,684,292
Undeveloped Details/Contingency	15%				$334,641	$552,644
TOTAL CAPITAL AND FIXED COSTS					$2,565,581	$4,236,936

OPERATION AND MAINTENANCE COSTS

Item		Quantity	Unit	Annual Cost Low	Annual Cost High	Present Worth Low	Present Worth High
Monitoring							
Post-dredging Sampling		1	Lump Sum	$26,700	$30,000	$26,700	$30,000
Long-term Monitoring (once every 5 years)		1-30	5 Years	$30,300	$50,000	$84,200	$139,100
Dive Inspections (once every five years)		1-30	5 Years	$10,000	$10,000	$27,700	$27,700
5 Year Review Reporting		1-30	5 Years	$15,000	$20,000	$41,700	$55,600
O&M PRESENT WORTH COSTS SUBTOTAL						$180,300	$252,400
Undeveloped Details/Contingency	20%					$36,100	$50,500
TOTAL PRESENT WORTH MONITORING COSTS						$216,400	$302,900

TOTAL	**$2,781,981**	**$4,539,836**

Notes:
1. This opinion of probable cost was prepared using costs considered appropriate for typical operations. It is intended for use in comparing the relative cost of remedial alternatives. Actual costs may differ.
2. An interest rate of 5% was used in present worth calculations

Prp. By. MTM Date. 4/3/07
Chk. By AJI Date 4/3/07

Appendix C:

State Concurrence Letter

Ohio EPA

State of Ohio Environmental Protection Agency

Southeast District Office

2195 Front Street
Logan, Ohio 43138

TELE: (740) 385-8501 FAX: (740) 385-6490
www.epa.state.oh.us

Ted Strickland, Governor
Lee Fisher, Lieutenant Governor
Chris Korleski, Director

June 28, 2007

LAWRENCE COUNTY
ALLIEDSIGNAL - TAR PLANT
DERR CORRESPONDENCE

Ms. Brenda Jones
Remedial Project Manager
U.S. EPA, Region V
Office of Superfund, SR-6J
77 West Jackson Boulevard
Chicago, Illinois 60604

RE: Comments on Draft Proposed Plan
AlliedSignal Tar Plant
Ironton, Ohio

Dear Ms. Jones:

Ohio EPA has reviewed U.S. EPA's draft Proposed Plan for the above-referenced site. In our review of this Plan, we have also considered U.S. EPA's 1990 Record of Decision (ROD) for the Coke Plant/Lagoon Area operable unit, which established a remedy to address contaminated groundwater beneath all areas of the site, including the Tar Plant. Specifically, we note that Section X of the 1990 ROD established MCLs as cleanup objectives for groundwater.

Our comments on the selected remedy for each media are presented below.

Soil

U.S. EPA has selected a low-permeability soil cap (Alternative 3b) constructed to meet the requirements of Ohio EPA's solid waste rules, as detailed in OAC 3745-27-08. The cap would be constructed over site soils of the Main Parcel that exceed standards for leaching of organic contaminants from soil to groundwater, human health direct contact risk, and ecological risk. The soils of the River Parcel would be covered only with a 2-foot soil barrier and additional erosion protection materials to avoid damage to which a low-permeability cap could be subjected due to potential flooding.

Ohio EPA fully concurs with the selection of this remedy component, noting the following:

If you would like to discuss these comments further, please call me at 740-380-5247.

Sincerely,

Kevin O'Hara
Site Coordinator
Division of Emergency and Remedial Response

KO/jg

Appendix D:

Administrative Record Index

U.S. ENVIRONMENTAL PROTECTION AGENCY
REMEDIAL ACTION

ADMINISTRATIVE RECORD
FOR
ALLIED CHEMICAL/IRONTON COKE SITE
OPERABLE UNIT #3 - TAR PLANT
IRONTON, LAWRENCE COUNTY, OHIO

ORIGINAL
JULY 9, 2007

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
1	00/00/00	U.S. EPA	File	Notes: Comments on Phase 1 OU3 Risk Assessments	
2	00/00/00	U.S. EPA	File	Notes: Comments on Phase 1 Remedial Investigation Report	
3	00/00/00	U.S. EPA	U.S. EPA	Sign-in Sheet for U.S. EPA and Honeywell Meeting For the Allied Chemical/ Ironton Coke Site	1
4	00/00/00	Jaffess, S. U.S. EPA		Email Message re: Adding Item to Agenda re: How the CPLA Project Went at the Allied Chemical/Ironton Coke Site	1
5	00/00/00	U.S. EPA	U.S. EPA	Excerpt re: Compliance Monitoring for the Allied Chemical/Ironton Coke Site	22
6	00/00/00	U.S. EPA	U.S. EPA	Excerpt re: System Modif- cation/Alternative Remedial Action for the Allied Chemical/Ironton Coke Site	3
7	1987-1998	U.S. EPA	Public	Administrative Record for Operable Unit #2 Coke Plant/ Lagoon Area at the Allied Chemical/Ironton Coke Site (Original, Updates #1-11, Addendum) [DOCUMENTS CON- TAINED ON THE AR INDEXES ARE INCORPORATED BY REFERENCE INTO THE OU#3 AR)	
8	1988-1999	U.S. EPA	Public	Administrative Record for the Goldcamp Operable Unit at the Allied Chemical/ Ironton Coke Site (Original, Updates #1) [DOCUMENTS CON- TAINED ON THE AR INDEXES ARE INCORPORATED BY REFERENCE INTO THE OU#3 AR)	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
9	11/03/97	Paterson, N. AlliedSignal, Inc.	Alcamo, T. U.S. EPA and K. Gilmer Ohio EPA	Letter re: Quarterly Report for Third Quarter 1997 for the Allied Chemical/Ironton Coke Site	2
10	12/22/97	Mankowski, M. U.S. EPA	Lewis, M. Allied Signal, Inc.	Letter re: Change of Project Manager at the Allied Chemical/Ironton Coke Site	1
11	01/27/98	Paterson, N. Allied Signal, Inc.	Mankowski, M. U.S. EPA and C. Ackman Ohio EPA	Letter re: Fourth Quarter 1997 Quarterly Report for the Allied Chemical/Ironton Coke Site	2
12	05/05/98	Savarese, R. AlliedSignal, Inc.	Ackman, O. Ohio EPA and Mankowski, M. U.S. EPA	Letter re: Request for Extension for the First Quarter 1998 Quarterly Report for the Allied Chemical/ Ironton Coke Site	1
13	05/29/98	Shott, D. IT Corp- Oration	Mankowski, M. U.S. EPA and O. Ackman Ohio EPA	Letter re: First Quarter 1998 Quarterly Report for the Allied Chemical/Ironton Coke Site	2
14	06/01/98	Tetra Tech EM, Inc.	U.S. EPA	Draft Health and Safety Safety Plan for Remedial Action Oversight at the Allied Chemical/ Ironton Coke Site w/cover Letter	13
15	07/21/98	Shott, D. IT Corp- oration	Mankowski, M. U.S. EPA and O. Ackman Ohio EPA	Letter re: Second Quarter 1998 Quarterly Report for the Allied Chemical/Ironton Coke Site	2
16	01/22/99	Shott, D. IT Corp- oration	Mankowski, M. U.S. EPA and O. Ackman Ohio EPA	Letter re: Fourth Quarter 1998 Quarterly Report for the Allied Chemical/Ironton Coke Site	2
17	04/16/99	Shott, D. IT Corp- oration	Mankowski, M. U.S. EPA and O. Ackman Ohio EPA	Letter re: First Quarter 1999 Quarterly Report for the Allied Chemical/Ironton Coke Site	3
18	03/25/99	Shott, D. IT Corporation	Mankowski, M. U.S. EPA and O. Ackman Ohio EPA	Letter re: Supplemental Information for Groundwater Modeling and Capture Zone Analysis for the Allied Chemical/Ironton Coke Site	

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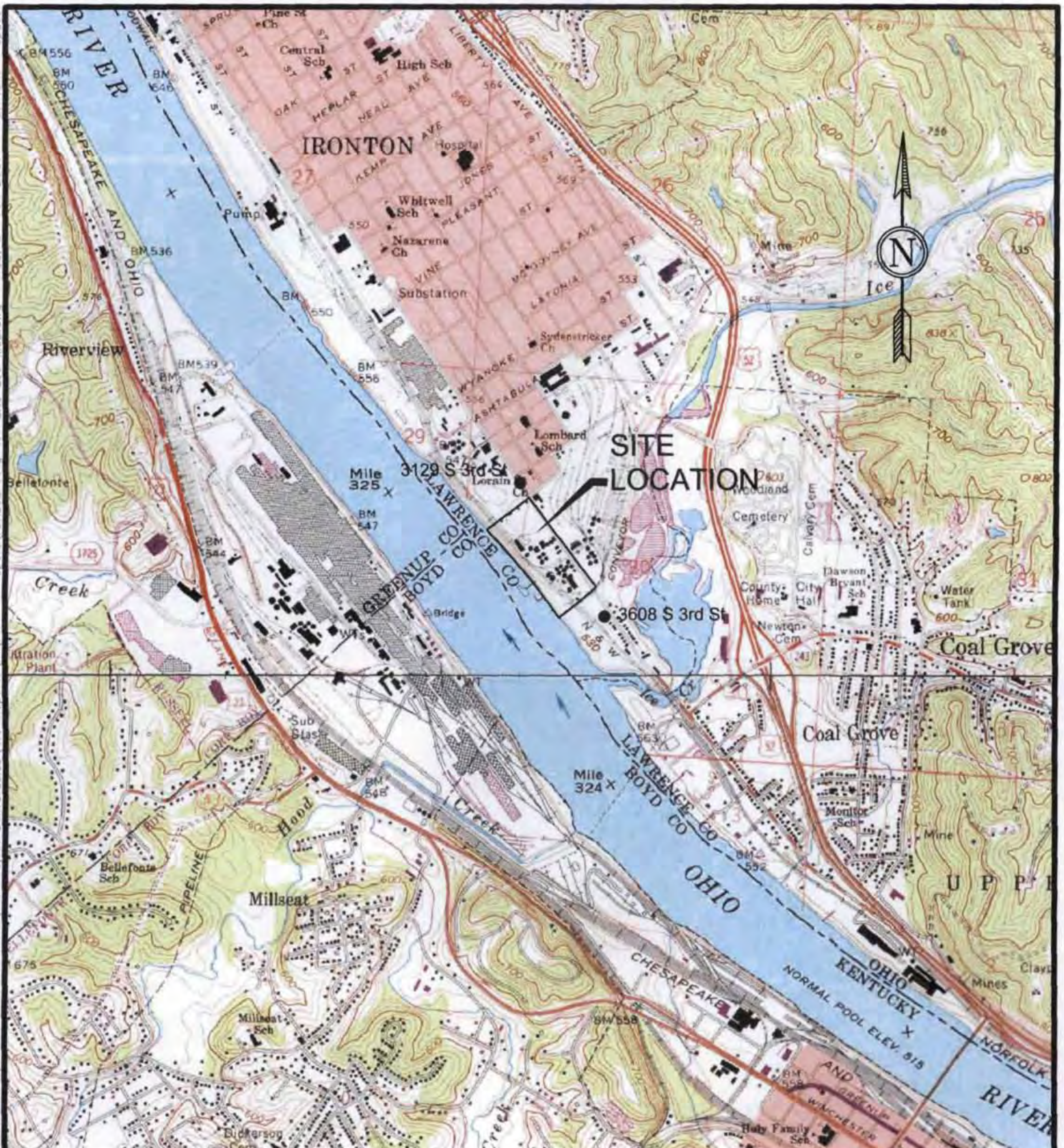
271	01/04/07	Jones, B., U.S. EPA	Geadelmann, C., Honeywell International, Inc.	Letter re: U.S. EPA Comments on Proposed Scope of Work, Additional Remedial Investigation for the Ironton Tar Plant	
272	01/04/07	Koeneman, J. & S. Conn, MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	Letter re: November 2006 Groundwater Capture Map for the Honeywell-Ironton Facility	
273	01/12/07	Geadelmann, C., Honeywell	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	December 2006 Progress Report for the Ironton Tar Plant Site	
274	01/26/07	MACTEC Engineering & Consulting, Inc.	U.S. EPA/ Ohio EPA	Response to U.S. EPA Comments on the Draft Phase 1A Remedial Inves-tigation Report for the Allied Chemical & Ironton Coke Honeywell Coal Tar Facility	
275	02/02/07	Koeneman, J. & S. Conn, MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	Letter re: December 2006 Groundwater Capture Map for the Honeywell-Ironton Facility	
276	02/08/07	Silvestri, N., SulTRAC	Jones, B., U.S. EPA	Letter re: Technical Review Comments on Draft Alternatives Screening Technical Memorandum for the Allied Chemical & Ironton Coke Honeywell Coal Tar Facility	
277	02/08/07	Silvestri, N., SulTRAC	Jones, B., U.S. EPA	Letter re: Technical Review Comments on Phase 1A Remedial Investigation Report for the Allied Chemical & Ironton Coke Honeywell Coal Tar Facility	
278	02/15/07	Geadelmann, C., Honeywell	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	January 2007 Progress Report for the Ironton Tar Plant Site	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
279	02/16/07	O'Hara, K., Ohio EPA	Jones, B., U.S. EPA	Letter re: Ohio EPA Comments on the RI/FS Documents for the Allied Signal Tar Plant	
280	03/00/07	Honeywell	File	Remedial Investigation, Risk Assessment and Comparative Analysis of Alternatives for the Tar Plant Site	
281	03/09/07	Geadelmann, C., Honeywell	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	February 2007 Progress Report for the Ironton Tar Plant Site	
282	03/12/07	Jones, B., U.S. EPA	Geadelmann, C., Honeywell International, Inc.	Letter re: U.S EPA Comments on the January 26, 2007 Phase 1A Remedial Investigation Report for the Allied Chemical & Ironton Coke Honeywell Coal Tar Facility	
283	03/12/07	Jones, B., U.S. EPA	Geadelmann, C., Honeywell International, Inc.	Letter re: U.S EPA Comments on the January 26, 2007 Draft Technical Memorandum Comparative Analysis of Alternatives for the Ironton Tar Plant	
284	03/13/07	Koeneman, J. & S. Conn, MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	Letter re: January 2007 Groundwater Capture Map for the Honeywell-Ironton Facility	
285	03/23/07	O'Hara, K., Ohio EPA	Jones, B., U.S. EPA	E-Mail Transmission re: Revised ARAR List for the Tar Plant	
286	04/13/07	Conn, S. & B. Baker, MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	Letter re: February 2007 Groundwater Capture Map for the Honeywell-Ironton Facility	
287	04/13/07	Geadelmann, C., Honeywell	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	March 2007 Progress Report for the Ironton Tar Plant Site	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
288	04/26/07	Bondy, G. & L. Stirban, MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA	Phase 1A Remedial Investigation Report for the Allied Chemical & Ironton Coke Honeywell Coal Tar Facility: Volume 1 (Text)	
289	04/26/07	Bondy, G. & L. Stirban, MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA	Phase 1A Remedial Investigation Report for the Allied Chemical & Ironton Coke Honeywell Coal Tar Facility: Volume 2 (Tables, Figures and Appendices A-F)	
290	04/26/07	Jones, B., U.S. EPA	Geadelmann, C., Honeywell International,	Letter: U.S. EPA Response to April 16, 2007 Letter re: Update on Efforts to Obtain Access Southeast of Operable Unit 3 Tar Plant at the Allied Chemical/Ironton Coke Facility w/ Attachment	
291	04/26/07	Bondy, G. & L. Stirban MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA	Feasibility Study Report (DRAFT) for the Allied Chemical/Ironton Coke Facility Operable Unit 3 Tar Plant w/Cover Letter	
292	04/27/07	Tielsch, J., U.S. EPA	Jones, B., U.S. EPA	Memorandum: ORC Comments on Ohio ARARs for the Tar Plant	
293	05/04/07	Conn, S. & B. Baker, MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	Letter re: March 2007 Groundwater Capture Map for the Honeywell-Ironton Facility	
294	05/08/07	Tielsch, J., U.S. EPA	Jones, B., U.S. EPA	Memorandum re: ORC Comments on the Feasibility Study for the Allied/Ironton Tar Plant	
295	05/15/07	Geadelmann, C., Honeywell	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	April 2007 Progress Report for the Ironton Tar Plant Site	
296	05/22/07	Conn, S. & B. Baker, MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA & K. O'Hara, Ohio EPA	Letter re: April 2007 Groundwater Capture Map for the Honeywell-Ironton Facility	

NO.	DATE	AUTHOR	RECIPIENT	TITLE/DESCRIPTION	PAGES
297	05/25/07	Conn, S. Mactec Engin-eering and Consulting, Inc.	Jones, B. U.S. EPA and K. O'Hara Ohio EPA	Fourth Quarter 2006 Groundwater Monitoring Report for the Allied Chemical/Ironton Coke Site w/ cover letter	
298	06/06/07	Jones, B., U.S. EPA	Geadelmann, C., Honeywell International, Inc.	Letter re: U.S EPA Comments to Clarify and Streamline Submission of an Operable Unit 3 Feasibility Study Addendum for the Allied Chemical & Ironton Coke Site	
299	06/15/07	Bondy, G. & L. Stirban MACTEC Engineering & Consulting, Inc.	Jones, B., U.S. EPA	Feasibility Study Addendum for the Allied Chemical/ Ironton Coke Facility Operable Unit 3-Tar Plant w/Cover Letter	
300	07/09/07	Jones, B., U.S. EPA	Geadelmann, C., Honeywell International, Inc.	Letter re: Final Approval with Modifications of the April 26, 2007 Feasibility Study (DRAFT) and the Feasibility Study Addendum for the Allied Chemical/ Ironton Coke Site Operable Unit 3 - Tar Plant	
301	07/09/07	U.S. EPA	Public	Public Notice: EPA Proposes Cleanup Plan for Former Tar Plant at the Allied Chemical/Ironton Coke Site and Announcement of Public Comment Period	
302	07/00/07	U.S. EPA	Public	Proposed Plan for Former Tar Plant at the Allied Chemical/Ironton Coke Site	

Figures



SCALE

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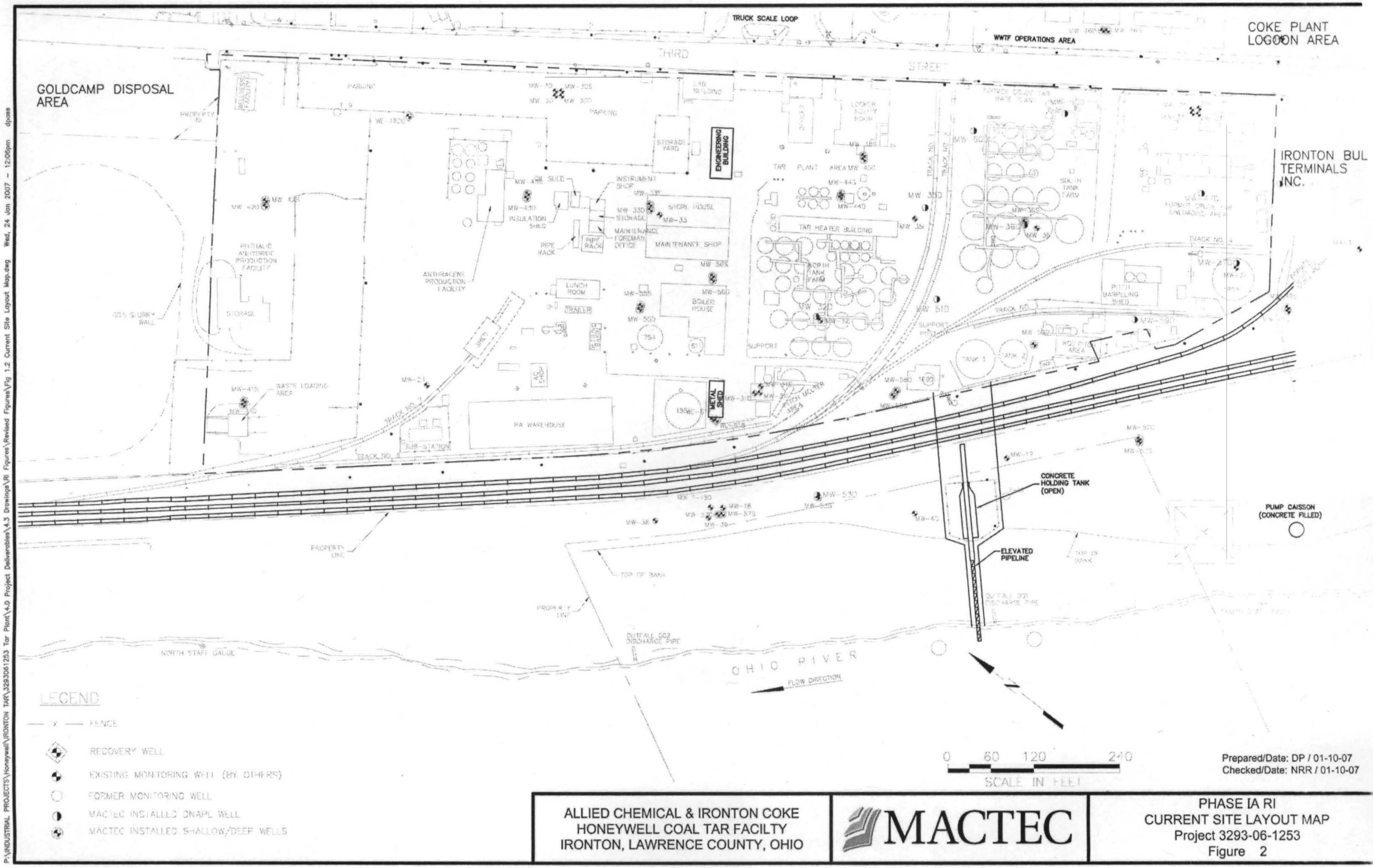
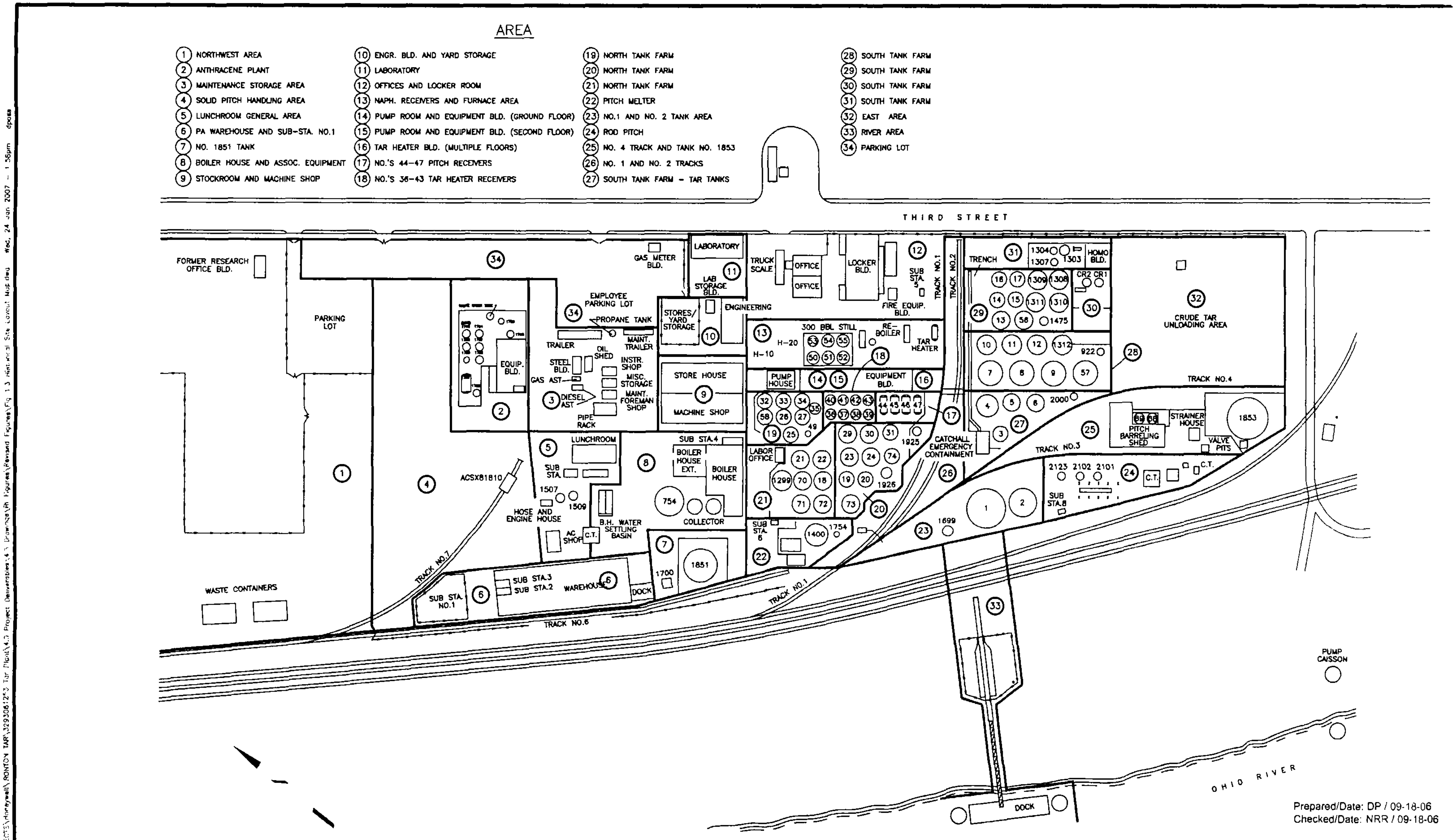
Prepared/Date: DP 01-10-07
Checked/Date: LS 01-10-07

ALLIED CHEMICAL & IRONTON COKE HONEYWELL COAL TAR FACILITY IRONTON, LAWRENCE COUNTY, OHIO	MACTEC	PHASE IA RI SITE LOCATION MAP Project 3293-06-1253 Figure 1

P:\INDUSTRIAL_PROJECTS\Honeywell\IRONTON_TAR\3293061253 Tar Plant\4.0 Project Deliverables\4.1 Reports\RI\Final RI Report\revised FFig 1.1 Site Loc Map.dwg Wed, 24 Jan 2007 - 10:14am dpgas


TRUCK SCALE LOOP
WWTF OPERATIONS AREA
COKE PLANT LOGOON AREA
GOLDCAMP DISPOSAL AREA
THIRD
STREET
ENGINEERING BUILDING
IRONTON BUL TERMINALS INC.
TAR HEATER BUILDING
MAINTENANCE SHOP
PA WAREHOUSE
METAL SHED
CONCRETE HOLDING TANK (OPEN)
PUMP CAISSON (CONCRETE FILLED)
ELEVATED PIPELINE
OHIO RIVER
FLOW DIRECTION
LEGEND
FENCE
RECOVERY WELL
EXISTING MONITORING WELL (BY OTHERS)
FORMER MONITORING WELL
MACTEC INSTALLED DNAPL WELL
MACTEC INSTALLED SHALLOW/DEEP WELLS
0 60 120 240
SCALE IN FEET
Prepared/Date: DP / 01-10-07
Checked/Date: NRR / 01-10-07
ALLIED CHEMICAL & IRONTON COKE
HONEYWELL COAL TAR FACILTY
IRONTON, LAWRENCE COUNTY, OHIO
MACTEC
PHASE IA RI
CURRENT SITE LAYOUT MAP
Project 3293-06-1253
Figure 2

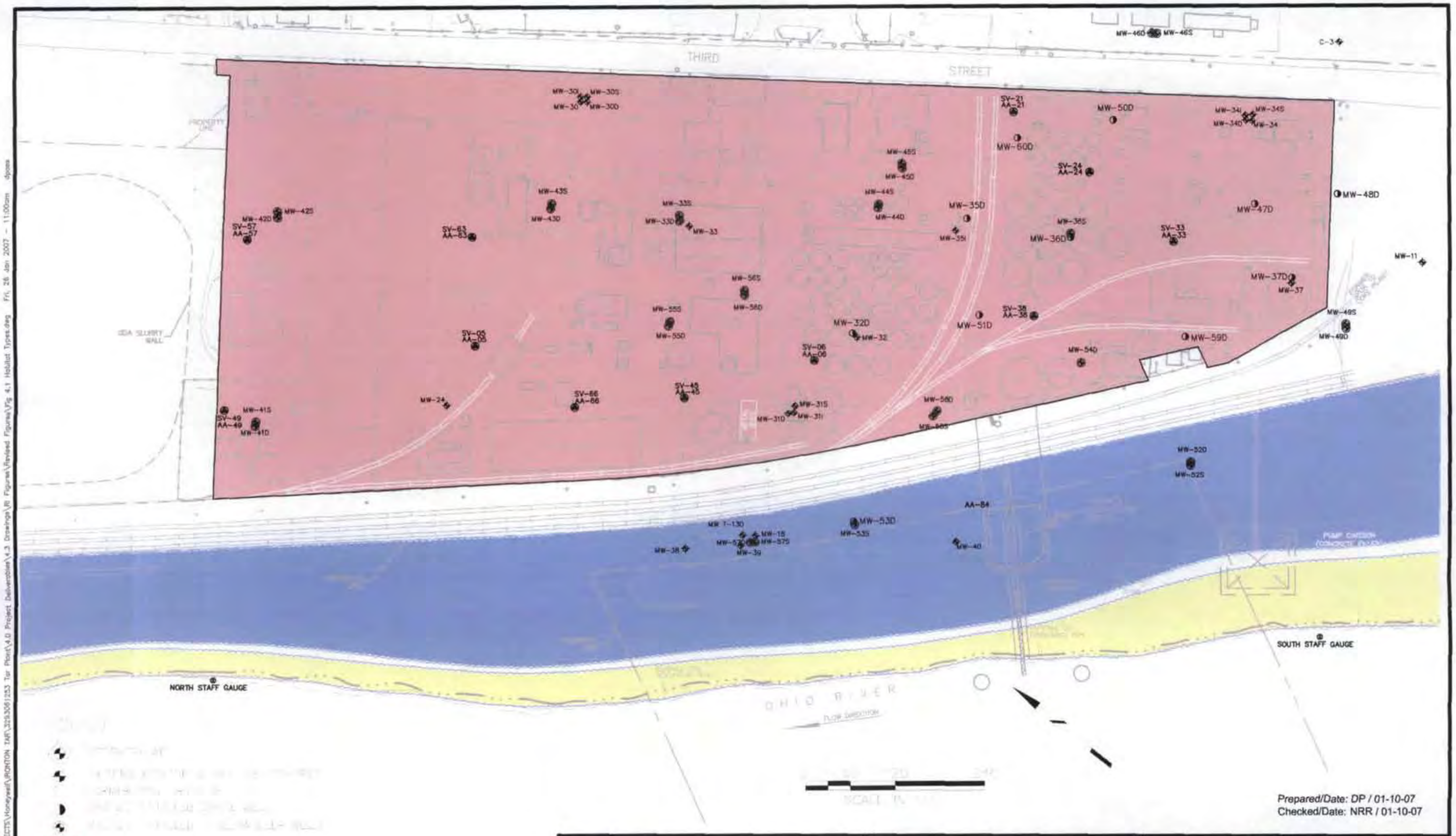


Prepared/Date: DP / 09-18-06
Checked/Date: NRR / 09-18-06

ALLIED CHEMICAL & IRONTON COKE
HONEYWELL COAL TAR FACILTY
IRONTON, LAWRENCE COUNTY, OHIO

MACTEC

PHASE IA RI
HISTORICAL SITE LAYOUT MAP
Project 3293-06-1253
Figure 3



ALLIED CHEMICAL & IRONTON COKE
HONEYWELL COAL TAR FACILTY
IRONTON, LAWRENCE COUNTY, OHIO

MACTEC

PHASE IA RI
HABITAT TYPES
Project 3293-06-1253
Figure 4

Figure 5 - Conceptual Site Model

Exposure Pathway Evaluation Flowchart - Current Land Use

Honeywell Ironton Tar Plant

Ironton, Ohio

Source Areas	Transport Mechanisms	Potentially Complete	Exposure Routes	Potential Receptors: On-Property: Residents	On-Property: Maintenance Workers	On-Property: Adult Visitors	On-Property: Commerical Workers	On-Property: Construction Workers	On-Property: Trespassers	Off-Property: Residents	Off-Property: Commercial Workers	Off-Property: Construction Workers	Off-Property: Recreational Users
Surficial Soil (<3 feet)		■	Inhalation / Dermal Contact		■	■			■				
Surficial Soil (<3 feet)	Wind Erosion and Dispersion	■	Inhalation of Particulates		■	■			■				
Surficial Soil (<3 feet)	Volatilization	■	Inhalation (Ambient)		■	■			■				
Surficial Soil (<3 feet)	Volatilization		Inhalation (Enclosed Space)										
Surficial Soil (<3 feet)	Leaching-Dissolved Phase												
Subsurface Soil (>3 feet)			Inhalation / Dermal Contact / Ingestion										
Subsurface Soil (>3 feet)	Volatilization	■	Inhalation (Ambient)		■	■							
Subsurface Soil (>3 feet)	Volatilization		Inhalation (Enclosed Space)										
Subsurface Soil (>3 feet)	Leaching-Dissolved Phase												
Groundwater			Ingestion (Potable Water)										
Groundwater			Dermal Contact										
Groundwater	Volatilization		Inhalation (Ambient)										
Groundwater	Volatilization		Inhalation (Enclosed Space)										
Groundwater	Surface Water												
Non-Aqueous Phase Liquid (NAPL)	Volatilization		Inhalation (Ambient)										
Non-Aqueous Phase Liquid (NAPL)	Volatilization		Inhalation (Enclosed Space)										
Non-Aqueous Phase Liquid (NAPL)	Dissolved-Phase												
Surface Water		■	Dermal Contact / Incidental Ingestion										■
Sediment		■	Dermal Contact										■

□ The exposure pathway is not complete.

■ The exposure pathway is potentially complete

Figure 5 - Conceptual Site Model (cont.)
Exposure Pathway Evaluation Flowchart - Future Land Use
Honeywell Ironton Tar Plant
Ironton, Ohio

Source Areas	Transport Mechanisms	Potentially Complete	Exposure Routes	On-Property: Residents	On-Property: Commercial Workers (Outdoor)	On-Property: Commercial worker (Indoor)	On-Property: Construction Workers	On-Property: Trespassers	Off-Property: Residents	Off-Property: Commercial Workers	Off-Property: Construction Workers	Off-Property: Recreational Users
Surficial Soil (<3 feet)		X	Ingestion / Dermal Contact		X		X	X				
Surficial Soil (<3 feet)	Wind Erosion and Dispersion	X	Inhalation of particulates		X		X	X				
Surficial Soil (<3 feet)	Volatilization	X	Inhalation (Ambient)		X		X	X				
Surficial Soil (<3 feet)	Volatilization		Inhalation (Enclosed Space)									
Surficial Soil (<3 feet)	Leaching-Dissolved Phase											
Subsurface Soil (>3 feet)		X	Ingestion/Dermal Contact				X					
Subsurface Soil (>3 feet)	Volatilization	X	Inhalation (Ambient)				X					
Subsurface Soil (>3 feet)	Volatilization	X	Inhalation (Enclosed Space)		X	X						
Subsurface Soil (>3 feet)	Leaching-Dissolved Phase											
Groundwater		X	Ingestion (Potable Water)		X	X						
Groundwater			Dermal Contact									
Groundwater	Volatilization		Inhalation (Ambient)									
Groundwater	Volatilization	X	Inhalation (Enclosed Space)		X	X						
Groundwater	Surface Water											
Non-Aqueous Phase Liquid (NAPL)	Volatilization		Inhalation (Ambient)									
Non-Aqueous Phase Liquid (NAPL)	Volatilization		Inhalation (Enclosed Space)									
Non-Aqueous Phase Liquid (NAPL)	Dissolved-Phase											
Surface Water		X	Dermal Contact / incidental Ingestion									X
Sediment		X	Dermal Contact									X

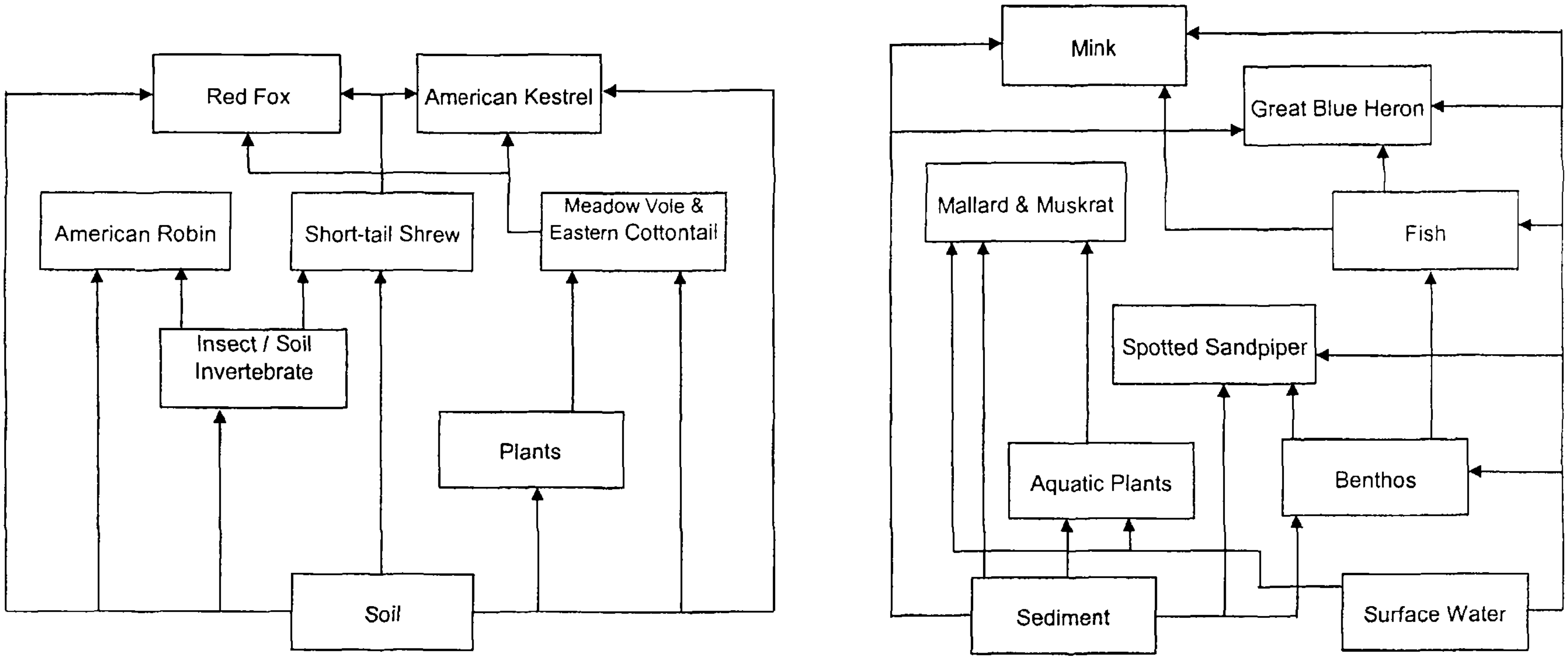
☐ The exposure pathway is not complete or insignificant.

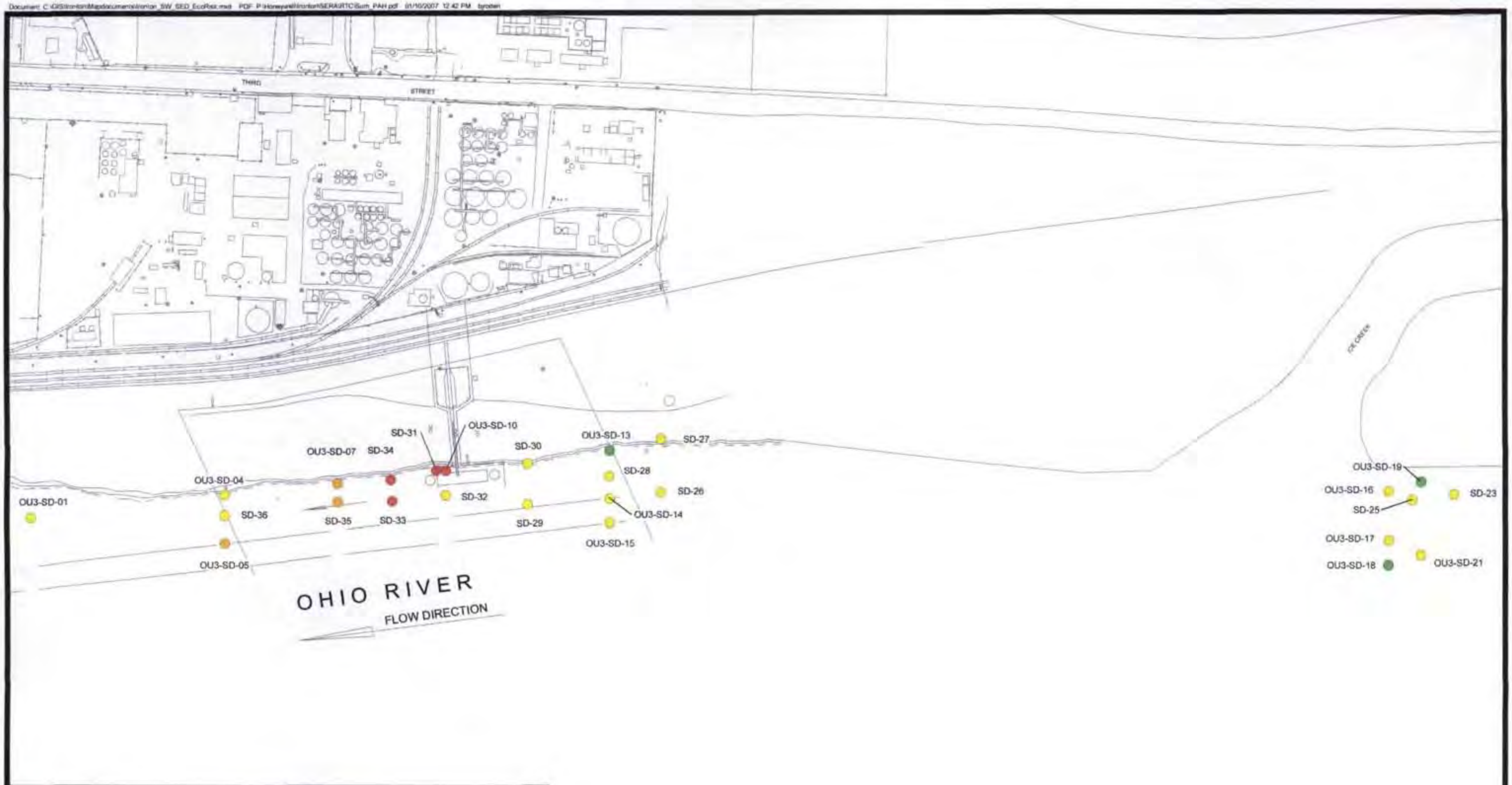
▦ The exposure pathway is potentially complete.

FIGURE 6

IRONTON TAR PLANT
Lawrence County, Ohio

Ecological Conceptual Site Model





Legend

- ESBTU >= 100
- ESBTU >= 10 and ESBTU < 100
- ESBTU >= 1 and ESBTU < 10
- ESBTU < 1

Notes:

ESBTU = Equilibrium Partitioning Sediment Benchmark Toxic Unit calculated in Table 8.24

Prepared/Date: BJR 01/10/07
Checked/Date: ALF 01/11/07

ALLIED CHEMICAL & IRONTON COKE
HONEYWELL COAL TAR FACILITY
IRONTON, LAWRENCE COUNTY, OHIO

MACTEC

PHASE 1A RI
ESBTU for PAHs
Project 3293-06-1253
Figure 7

ALLIED CHEMICAL & IRONTON COKE HONEYWELL COAL TAR FACILTY IRONTON, LAWRENCE COUNTY, OHIO	MACTEC	Extent of Soil Contamination Future Commercial/Industrial Outdoor Worker Project 3293-07-1298 Figure 8

Tables

TABLE 1
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - SOIL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Exposure Point	Chemical of Concern	Units	Arithmetic Mean	95% UCL (distribution)		Maximum (1) Concentration (Qualifier)		Exposure Point Concentration: EPC	Units	Statistic	Rationale
River Parcel (0-2 ft)	**Volatile Organics**										
	Benzene	mg/kg	0.15	0.72	NP	1.6		0.72	mg/kg	95% UCL - NP [a]	(3)
	Semivolatile Organics										
	2-Methylnaphthalene	mg/kg	3.5	23	NP	43	J	23	mg/kg	95% UCL - NP [a]	(3)
	Acenaphthene	mg/kg	75	533	LN	970		533	mg/kg	95% UCL - LN [e]	(3)
	Benzo(a)anthracene	mg/kg	105	856	LN	2000		856	mg/kg	95% UCL - LN [c]	(3)
	Benzo(a)pyrene	mg/kg	132	1045	LN	2400		1045	mg/kg	95% UCL - LN [e]	(3)
	Benzo(b)fluoranthene	mg/kg	113	854	LN	1900		854	mg/kg	95% UCL - LN [e]	(3)
	Benzo(ghi)perylene	mg/kg	115	911	LN	2100		911	mg/kg	95% UCL - LN [e]	(3)
	Benzo(k)fluoranthene	mg/kg	85	718	LN	1700		718	mg/kg	95% UCL - LN [e]	(3)
	Chrysene	mg/kg	111	899	LN	2100		899	mg/kg	95% UCL - LN [e]	(3)
	Dibenzo(a,h)anthracene	mg/kg	32	269	LN	630		269	mg/kg	95% UCL - LN [e]	(3)
	Fluoranthene	mg/kg	197	1619	LN	3800		1619	mg/kg	95% UCL - LN [e]	(3)
	Fluorene	mg/kg	16	123	LN	270		123	mg/kg	95% UCL - LN [e]	(3)
	Indeno(1,2,3-cd)pyrene	mg/kg	101	818	LN	1900		818	mg/kg	95% UCL - LN [e]	(3)
	Naphthalene	mg/kg	8.2	36	LN	150		36	mg/kg	95% UCL - LN [f]	(3)
	Phenanthrene	mg/kg	113	968	LN	2300		968	mg/kg	95% UCL - LN [e]	(3)
	Pyrene	mg/kg	149	1233	LN	2900		1233	mg/kg	95% UCL - LN [e]	(3)
	Total Phenols	mg/kg	1.0	2.0	NP	5.4		2.0	mg/kg	95% UCL - NP [b]	(3)
	PCBs										
	Aroclor 1248	mg/kg	0.061	NC		0.11	J	0.11	mg/kg	Maximum	(2)
	Inorganics										
	Arsenic	mg/kg	8.3	10	G	18.7	J	10	mg/kg	95% UCL - G [i]	(3)
	Nitrogen, as Ammonia	mg/kg	2.8	13	NP	23		13	mg/kg	95% UCL - NP [a]	(3)
River Parcel (2-10 ft)	**Semivolatile Organics**										
	Benzo(a)pyrene	mg/kg	1.1	14	G	0.075		0.075	mg/kg	Maximum	(2)
	Inorganics										
	Arsenic	mg/kg	7.2	9.8	N	9.0	J	9.0	mg/kg	Maximum	(2)
	Nitrogen, as Ammonia	mg/kg	0.53	3.2	NP	1.8	J	1.8	mg/kg	Maximum	(2)
Main Parcel (0-2 ft)	**Volatile Organics**										
	Benzene	mg/kg	0.51	1.8	NP	16		1.8	mg/kg	95% UCL - NP [c]	(3)
	Xylenes (total)	mg/kg	3.8	21	NP	130		21	mg/kg	95% UCL - NP [a]	(3)
	Semivolatile Organics										
	1-Methylnaphthalene	mg/kg	27	290	NP	370		290	mg/kg	95% UCL - NP [a]	(3)
	2-Methylnaphthalene	mg/kg	83	128	LN	1200		128	mg/kg	95% UCL - LN [g]	(3)
Main Parcel (0-2 ft) (cont)	Acenaphthene	mg/kg	105	155	G	1100		155	mg/kg	95% UCL - G [k]	(3)
	Acenaphthylene	mg/kg	19	120	NP	890		120	mg/kg	95% UCL - NP [a]	(3)
	Anthracene	mg/kg	154	233	G	4300		233	mg/kg	95% UCL - G [k]	(3)
	Benzo(a)anthracene	mg/kg	142	201	G	1500		201	mg/kg	95% UCL - G [k]	(3)
	Benzo(a)pyrene	mg/kg	158	225	G	2000		225	mg/kg	95% UCL - G [k]	(3)

Prepared by: BJR 1/9/07
Checked by. JHP 1/9/07

TABLE 1
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - SOIL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

								Exposure Point Concentration			
Exposure Point	Chemical of Concern	Units	Arithmetic Mean	95% UCL (distribution)		Maximum (1) Concentration (Qualifier)		EPC	Units	Statistic	Rationale
	Benzo(b)fluoranthene	mg/kg	167	237	G	2100		237	mg/kg	95% UCL - G [k]	(3)
	Benzo(ghi)perylene	mg/kg	124	178	G	1400		178	mg/kg	95% UCL - G [k]	(3)
	Benzo(k)fluoranthene	mg/kg	75	107	G	990	J	107	mg/kg	95% UCL - G [k]	(3)
	Chrysene	mg/kg	142	201	G	1400	J	201	mg/kg	95% UCL - G [k]	(3)
	Dibenzo(a,h)anthracene	mg/kg	30	43	G	370		43	mg/kg	95% UCL - G [k]	(3)
	Fluoranthene	mg/kg	378	541	G	4800		541	mg/kg	95% UCL - G [k]	(3)
	Fluorene	mg/kg	98	351	NP	1600		351	mg/kg	95% UCL - NP [a]	(3)
	Indeno(1,2,3-cd)pyrene	mg/kg	104	149	G	1200		149	mg/kg	95% UCL - G [k]	(3)
	Naphthalene	mg/kg	415	1234	LN	11000		1234	mg/kg	95% UCL - LN [g]	(3)
	Phenanthrene	mg/kg	340	497	G	5800		497	mg/kg	95% UCL - G [k]	(3)
	Pyrene	mg/kg	244	347	G	2900		347	mg/kg	95% UCL - G [k]	(3)
	Total Phenols	mg/kg	8.8	32	NP	280	J	32	mg/kg	95% UCL - NP [c]	(3)
	PCBs										
	Aroclor 1248	mg/kg	0.48	1.3	G	4.8	J	1.3	mg/kg	95% UCL - G [k]	(3)
	Aroclor 1260	mg/kg	1.1	2.9	G	6.5		2.9	mg/kg	95% UCL - G [k]	(3)
	Inorganics										
	Arsenic	mg/kg	5.7	6.5	LN	18.6	J	6.5	mg/kg	95% UCL - LN [h]	(3)
	Nitrogen, as Ammonia	mg/kg	6.2	15	NP	70		15	mg/kg	95% UCL - NP [c]	(3)
Main Parcel (2-10 ft)	**Volatile Organics**										
	Benzene	mg/kg	1.4	9.7	NP	21		9.7	mg/kg	95% UCL - NP [a]	(3)
	Xylenes (total)	mg/kg	6.8	54	NP	120		54	mg/kg	95% UCL - NP [a]	(3)
	Semivolatile Organics										
	1-Methylnaphthalene	mg/kg	51	124	N	170		124	mg/kg	95% UCL - N [l]	(3)
	2-Methylnaphthalene	mg/kg	51	92	NP	350		92	mg/kg	95% UCL - NP [d]	(3)
	Acenaphthene	mg/kg	140	721	NP	1900		721	mg/kg	95% UCL - NP [d]	(3)
	Benzo(a)anthracene	mg/kg	170	549	G	3900		549	mg/kg	95% UCL - G [k]	(3)
	Benzo(a)pyrene	mg/kg	181	1822	LN	4300		1822	mg/kg	95% UCL - LN [a]	(3)
	Benzo(b)fluoranthene	mg/kg	196	1990	LN	4700		1990	mg/kg	95% UCL - LN [a]	(3)
	Benzo(ghi)perylene	mg/kg	143	1480	LN	3500		1480	mg/kg	95% UCL - LN [a]	(3)
	Benzo(k)fluoranthene	mg/kg	91	1939	NP	2100		1939	mg/kg	95% UCL - NP [d]	(3)
Main Parcel (2-10 ft) (cont)	Chrysene	mg/kg	148	472	G	3400		472	mg/kg	95% UCL - G [k]	(3)
	Dibenzo(a,h)anthracene	mg/kg	31	291	NP	680		291	mg/kg	95% UCL - NP [d]	(3)
	Fluoranthene	mg/kg	328	2293	NP	6100		2293	mg/kg	95% UCL - NP [d]	(3)
	Fluorene	mg/kg	59	172	NP	460		172	mg/kg	95% UCL - NP [d]	(3)
	Indeno(1,2,3-cd)pyrene	mg/kg	121	1228	NP	2900		1228	mg/kg	95% UCL - NP [a]	(3)
	Naphthalene	mg/kg	319	1673	NP	4100		1673	mg/kg	95% UCL - NP [d]	(3)
	Phenanthrene	mg/kg	258	1431	NP	3200		1431	mg/kg	95% UCL - NP [d]	(3)
	Pyrene	mg/kg	281	2790	LN	5800		2790	mg/kg	95% UCL - LN [g]	(3)
	Total Phenols	mg/kg	20	67	LN	220	J	67	mg/kg	95% UCL - LN [f]	(3)
	Inorganics										

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 1
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - SOIL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

								Exposure Point Concentration			
Exposure Point	Chemical of Concern	Units	Arithmetic Mean	95% UCL (distribution)		Maximum (1) Concentration (Qualifier)		EPC	Units	Statistic	Rationale
	Arsenic	mg/kg	5.5	6.6	G	18.6	J	6.6	mg/kg	95% UCL - G [i]	(3)
	Nitrogen, as Ammonia	mg/kg	4.2	19	NP	29	J	19	mg/kg	95% UCL - NP [a]	(3)

(1) Arithmetic mean is calculated using one half the detection limit for nondetects.
(2) The maximum detected concentration is used as the EPC because it is lower than the calculated 95% UCL.
(3) - UCL - The 95% UCL is used as the EPC because the calculated 95% UCL is less than the maximum detected concentration.
UCLs are calcualated using ProUCL (V. 3.02); documentation of calculations is provided in Appendix E.

NP - Non-Parametric distribution
- [a] - 99% Chebyshev (Mean, Sd) UCL
- [b] - 95% Chebyshev (Mean, Sd) UCL
- [c] - 97.5% Chebyshev (Mean, Sd) UCL
- [d] - Hall's Bootstrap UCL

LN - Log normal distribution
- [e] - 99% Chebyshev (Mean, Sd) UCL
- [f] - 97.5% Chebyshev (MVUE) UCL
- [g] - Hall's Bootstrap UCL
- [h] - 95% H-UCL

G - Gamma Distribution
- [i] - Approximate Gamma UCL
- [k] - Adjusted Gamma UCL

N - Normal distribution
- [l] - Student's-t UCL

mg/kg = milligrams per kilogram
EPC = Exposure Point Concentration
UCL = Upper Confidence Limit on the arithmetic mean
NC = Not Calculated

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 2
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - SURFACE WATER
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

						Exposure Point Concentration			
Exposure Point	Chemical of Concern	Units	Arithmetic Mean (1)	95% UCL (distribution)	Maximum Concentration (Qualifier)	EPC	Units	Statistic	Rationale
Ohio River	**Volatile Organics**								
	Tetrachloroethene	mg/L	0.00024	0.00025 NP	0.00017 J	0.00017	mg/L	Maximum	(2)
	Semivolatile Organics								
	Benzo(a)anthracene	mg/L	0.00012	0.00021 NP	0.00066	0.00021	mg/L	95% UCL - NP [a]	(3)
	Benzo(a)pyrene	mg/L	0.00011	0.00014 NP	0.00044	0.00014	mg/L	95% UCL - NP [b]	(3)
	Benzo(b)fluoranthene	mg/L	0.00011	0.00013 NP	0.00043	0.00013	mg/L	95% UCL - NP [b]	(3)
	Naphthalene	mg/L	0.00013	0.00019 NP	0.0010	0.00019	mg/L	95% UCL - NP [b]	(3)
	Metals, Dissolved								
	Arsenic	mg/L	0.0033	0.0049 NP	0.00061 J	0.00061	mg/L	Maximum	(2)

(1) Arithmetic mean is calculated using one half the detection limit for nondetects.
(2) The maximum detected concentration is used as the EPC because it is lower than the calculated 95% UCL.
(3) - UCL - The 95% UCL is used as the EPC because the calculated 95% UCL is less than the maximum detected concentration.
UCLs are calcualated using ProUCL (V. 3.02); documentation of calculations is provided in Appendix E.
NP - Non-Parametric distribution
[a] - 95% Chebyshev (Mean, Sd) UCL
[b] - Mod-t UCL (Adjusted for skewness)

mg/L = milligrams per liter
EPC = Exposure Point Concentration
UCL = Upper Confidence Limit on the arithmetic mean

TABLE 3
SUMMARY OF EXPOSURE POINT CONENTRATIONS - SEDIMENT
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Exposure Point	Chemical of Concern	Units	Arithmetic Mean (1)	95% UCL (distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration EPC	Units	Statistic	Rationale
Ohio River Shoreline	**Semivolatile Organics**										
	2-Methylnaphthalene	mg/kg	0.14	0.28	G	0.36		0.28	mg/kg	95% UCL - G [a]	(3)
	Benzo(a)anthracene	mg/kg	5.3	9.1	N	15	J	9.1	mg/kg	95% UCL - N [b]	(3)
	Benzo(a)pyrene	mg/kg	5.5	9.7	N	17	J	9.7	mg/kg	95% UCL - N [b]	(3)
	Benzo(b)fluoranthene	mg/kg	5.2	18	G	13	J	13	mg/kg	Maximum	(2)
	Benzo(k)fluoranthene	mg/kg	3.5	12	G	12	J	12	mg/kg	Maximum	(2)
	Dibenzo(a,h)anthracene	mg/kg	1.5	8.9	G	5.8	J	5.8	mg/kg	Maximum	(2)
	Indeno(1,2,3-cd)pyrene	mg/kg	4.0	7.4	N	14	J	7.4	mg/kg	95% UCL - N [b]	(3)
	Naphthalene	mg/kg	0.67	0.64	LN	0.67		0.64	mg/kg	95% UCL - NP [c]	(3)
	PCBs										
	Aroclor 1248	mg/kg	0.033	0.038	N	0.038	J	0.038	mg/kg	Maximum	(2)
	Inorganics										
	Arsenic	mg/kg	6.9	9.4	N	11.7		9.4	mg/kg	95% UCL - N [b]	(3)
	Nitrogen, as Ammonia	mg/kg	11	89	G	63	J	63	mg/kg	Maximum	(2)

(1) Arithmetic mean is calculated using one half the detection limit for nondetects.
(2) The maximum detected concentration is used as the EPC because it is lower than the calculated 95% UCL.
(3) - UCL - The 95% UCL is used as the EPC because the calculated 95% UCL is less than the maximum detected concentration.
UCLs are calcualated using ProUCL (V. 3.02); documentation of calculations is provided in Appendix E.
G - Gamma Distribution
[a] - Approximate Gamma UCL
N - Normal distribution
[b] - Student's-t UCL
LN - Log normal distribution
[c] - 95% Chebyshev (MVUE) UCL
mg/kg = milligrams per kilogram
EPC = Exposure Point Concentration
UCL = Upper Confidence Limit on the arithmetic mean

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 4
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - AMBIENT AIR
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

							Exposure Point Concentration			
Exposure Point	Chemical of Concern	Units	Arithmetic Mean (1)	95% UCL (distribution)		Maximum Concentration (Qualifier)	EPC	Units	Statistic	Rationale
Main Parcel and River Parcel	**Volatile Organics**									
	Benzene	ug/m^3	0.41	0.53	NP	0.99	0.53	ug/m^3	95% UCL - NP [a]	(2)
	Naphthalene	ug/m^3	2.0	5.2	NP	10	5.2	ug/m^3	95% UCL - NP [b]	(2)

(1) Arithmetic mean is calculated using one half the detection limit for nondetects.
(2) - UCL - The 95% UCL is used as the EPC because the calculated 95% UCL is less than the maximum detected concentration.
UCLs are calcualated using ProUCL (V. 3.02); documentation of calculations is provided in Appendix E.
NP - Non-Parametric distribution
[a] - Mod-t UCL (Adjusted for skewness)
[b] - 95% Chebyshev (Mean, Sd) UCL

ug/m^3 = *micrograms per meter cubed.*
EPC = Exposure Point Concentration
UCL = Upper Confidence Limit on the arithmetic mean

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 5
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - SOIL VAPOR
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

							Exposure Point Concentration			
Exposure Point	Chemical of Concern	Units	Arithmetic Mean (1)	95% UCL (distribution)		Maximum Concentration (Qualifier)	EPC	Units	Statistic	Rationale
Main Parcel	**Volatile Organics**									
	Benzene	ug/m^3	18698	157250	G	180000	157250	ug/m^3	95% UCL - G [a]	(3)
	Ethylbenzene	ug/m^3	767	4932	G	6500	4932	ug/m^3	95% UCL - G [a]	(3)
	Naphthalene	ug/m^3	130	1295	NP	8.4	8.4	ug/m^3	Maximum	(2)
	Styrene	ug/m^3	204	2190	NP	2200	2190	ug/m^3	95% UCL - NP [b]	(3)
	Toluene	ug/m^3	8313	75820	LN	75000	75000	ug/m^3	Maximum	(2)
	Xylene (m,p)	ug/m^3	1443	14008	LN	14000	14000	ug/m^3	Maximum	(2)
	Xylene (o)	ug/m^3	392	3800	LN	3800	3800	ug/m^3	Maximum	(2)

(1) Arithmetic mean is calculated using one half the detection limit for nondetects.
(2) The maximum detected concentration is used as the EPC because it is lower than the calculated 95% UCL.
(3) - UCL - The 95% UCL is used as the EPC because the calculated 95% UCL is less than the maximum detected concentration.
UCLs are calcualated using ProUCL (V. 3.02); documentation of calculations is provided in Appendix E.
G - Gamma Distribution
[a] - Approximate Gamma UCL
NP - Non-Parametric distribution
[b] - 99% Chebyshev (Mean, Sd) UCL
ug/m^3 = micrograms per meter cubed.
EPC = Exposure Point Concentration
UCL = Upper Confidence Limit on the arithmetic mean

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 6
SUMMARY OF EXPOSURE SCENARIOS EVALUTAED IN RISK ASSESSMENT
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

	Exposure Point / Exposure Route								
Exposure Scenario	Surface Soil – Main Parcel	Subsurface Soil – Main Parcel	Surface Soil – Ohio River Parcel	Subsurface Soil – Ohio River Parcel	Groundwater	Ambient Air	Indoor Air	Surface Water – Ohio River	Sediment – Ohio River
Current Land Use									
Trespasser			DC						
Future Land Use									
Commercial/Industrial – Outdoor Worker	DC	DC [1]	DC	DC [1]	POT [1]	INH			
Commercial/Industrial – Indoor Worker	ING	ING [1]			POT [1]		INH		
Recreational Visitor	DC	DC [1]	DC	DC [1]		INH		DC	DER
Construction Worker	DC	DC	DC	DC		INH			

Notes: DC – Direct Contact: incidental ingestion & dermal contact
INH – Air Inhalation
ING – Ingestion
DER – Dermal Contact
POT – Potable Water Use: Ingestion
[1] – This exposure pathway is evaluated to help support risk management decision making.

TABLE 7
CANCER TOXICITY DATA -- ORAL/DERMAL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral Cancer Slope Factor	
	Value	Units		Value	Units		Source(s)	Date(s)
VOLATILES								
Benzene	5.5E-02	$(mg/kg/day)^{-1}$	100%	5.5E-02	$(mg/kg/day)^{-1}$	Known carcinogen	IRIS	January-00
Ethylbenzene	NA			NA		D	IRIS	January-00
Styrene	ND			ND		ND	IRIS	January-00
Tetrachloroethene	5.4E-01	$(mg/kg/day)^{-1}$	100%	5.4E-01	$(mg/kg/day)^{-1}$	NA	CALEPA	January-00
Toluene	NA			NA		D	IRIS	January-00
Xylenes (total)	NA			NA		Inadequate evidence	IRIS	January-00
SEMIVOLATILES								
2-Methylnaphthalene	NA			NA		Inadequate evidence	IRIS	January-00
Acenaphthene	ND			ND		ND	IRIS	January-00
Acenaphthylene	NA			NA		D	IRIS	January-00
Anthracene	NA			NA		D	IRIS	January-00
Benzo(a)anthracene	7.3E-01	$(mg/kg/day)^{-1}$	89%	7.3E-01	$(mg/kg/day)^{-1}$	B2	NCEA	Obtained from Region III RBC Table
Benzo(a)pyrene	7.3E+00	$(mg/kg/day)^{-1}$	89%	7.3E+00	$(mg/kg/day)^{-1}$	B2	IRIS	January-00
Benzo(b)fluoranthene	7.3E-01	$(mg/kg/day)^{-1}$	89%	7.3E-01	$(mg/kg/day)^{-1}$	B2	NCEA	Obtained from Region III RBC Table
Benzo(g,h,i)perylene	NA			NA		D	IRIS	January-00
Benzo(k)fluoranthene	7.3E-02	$(mg/kg/day)^{-1}$	89%	7.3E-02	$(mg/kg/day)^{-1}$	B2	NCEA	Obtained from Region III RBC Table
Chrysene	7.3E-03	$(mg/kg/day)^{-1}$	89%	7.3E-03	$(mg/kg/day)^{-1}$	B2	NCEA	Obtained from Region III RBC Table
Dibenzo(a,h)anthracene	7.3E+00	$(mg/kg/day)^{-1}$	89%	7.3E+00	$(mg/kg/day)^{-1}$	B2	NCEA	Obtained from Region III RBC Table
Fluoranthene	NA			NA		D	IRIS	January-00
Fluorene	NA			NA		D	IRIS	January-00
Indeno(1,2,3-cd)pyrene	7.3E-01	$(mg/kg/day)^{-1}$	89%	7.3E-01	$(mg/kg/day)^{-1}$	B2	NCEA	Obtained from Region III RBC Table
Naphthalene	NA		89%	NA		Cannot be determined	IRIS	January-00

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 7
CANCER TOXICITY DATA -- ORAL/DERMAL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Oral Cancer Slope Factor		Oral Absorption Efficiency for Dermal (1)	Absorbed Cancer Slope Factor for Dermal (2)		Weight of Evidence/ Cancer Guideline Description	Oral Cancer Slope Factor	
	Value	Units		Value	Units		Source(s)	Date(s)
Phenanthrene	NA			NA		D	IRIS	January-00
Phenol	NA			NA		Inadequate evidence	IRIS	January-00
Pyrene	NA			NA		D	IRIS	January-00
PESTICIDES/PCBs								
Aroclor 1248	2.0E+00	$(mg/kg/day)^{-1}$	80%	2.0E+00	$(mg/kg/day)^{-1}$	See PCBs		
Aroclor 1260	2.0E+00	$(mg/kg/day)^{-1}$	80%	2.0E+00	$(mg/kg/day)^{-1}$	See PCBs		
INORGANICS/METALS								
Arsenic	1.5E+00	$(mg/kg/day)^{-1}$	95%	1.5E+00	$(mg/kg/day)^{-1}$	A	IRIS	January-00
Cyanide	NA			NA		D	IRIS	January-00
Nitrate	ND			ND		ND	IRIS	January-00
Nitrogen, Ammonia	ND			ND		ND	IRIS	January-00

Notes:

In accordance with OSWER 9285.7-53, chronic RfDs are identified from the following heirarchy of sources:

Tier 1:

IRIS = Integrated Risk Information System: July, 2006

Tier 2:

PPRTV = Preliminary Peer-Reviewed Reference Toxicity Value April, 2006 Obtained from Region III RBC Table

Tier 3:

HEAST= Health Effects Assessment Summary Tables: FY 1997 / April, 2006 Verified using Region IX PRG and/or Region III RBC Table

CALEPA - California Environmental Protection Agency August, 2005

In addition, provisional RfDs developed by NCEA are presented for informational purposes and to be used on a case-by-case basis:

NCEA = National Center for Environmental Assessment: April, 2006 Obtained from Region III RBC Table

ND = no data available

(1) Values obtained from RAGS Volume 1 (Part E, Supplemental Guidance for Dermal Risk Assessment, Interim Guidance) (EPA, 2004)
Per this guidance, a value of 100% is used for analytes without published values.

(2) Adjusted Dermal SF = Oral SF / Oral to Dermal Adjustment Factor. Per RAGS Part E (USEPA, 2004), adjustments are only performed for chemicals that have an oral absorption efficiency of less than 50%.

Values for 2,4- and 2,6-dinitrotoluene based on IRIS for 2,4/2,6-Dinitrotoluene mixture

The value for chlordane is used as surrogate for the isomers.

Slope Factor for Benzo(a)Pyrene used for other carcinogenic PAHs, adjusted by Relative Potency Factors of 1.0 [benzo(a)pyrene, dibenz(a,h)anthracene]; 0.1 [benzo(a)anthracene, benzo(b)flouoranthene, indeno(1,2,3-c,d)pyrene]; 0.01 [benzo(k)fluoranthene]; 0.001 [chrysene].

PCB slope factors are applicable to Aroclors 1016, 1248, 1254, and 1260

[a] - The RfD for chloroform is protective for cancer risk.

Weight of Evidence:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

mg = milligram

kg = kilogram

BW = body weight

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 8
CANCER TOXICITY DATA -- INHALATION
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor (1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation Cancer Slope Factor	
	Value	Units	Value	Units		Source(s)	Date(s)
VOLATILES							
Benzene	7.80E-06	$(ug/m^3)^{-1}$	2.8E-02	$(mg/kg/day)^{-1}$	Known human carcinogen	IRIS	January-00
Ethylbenzene	NA		NA		D	IRIS	January-00
Styrene	ND		ND		ND	IRIS	January-00
Tetrachloroethene	5.90E-06	$(ug/m^3)^{-1}$	2.00E-02	$(mg/kg/day)^{-1}$	NA	CALEPA	January-00
Toluene	NA		NA		D	IRIS	January-00
Xylenes (total)	NA		NA		Inadequate data	IRIS	January-00
SEMIVOLATILES							
2-Methylnaphthalene	NA		NA		Inadequate	IRIS	January-00
Acenaphthene	ND		ND		ND	IRIS	January-00
Acenaphthylene	NA		NA		D	IRIS	January-00
Anthracene	NA		NA		D	IRIS	January-00
Benzo(a)anthracene	1.10E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CALEPA	January-00
Benzo(a)pyrene	1.10E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	B2	CALEPA	January-00
Benzo(b)fluoranthene	1.10E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CALEPA	January-00
Benzo(g,h,i)perylene	NA		NA		D	IRIS	January-00
Benzo(k)fluoranthene	1.10E-05	$(ug/m^3)^{-1}$	3.9E-02	$(mg/kg/day)^{-1}$	B2	CALEPA	January-00
Chrysene	1.10E-06	$(ug/m^3)^{-1}$	3.9E-03	$(mg/kg/day)^{-1}$	B2	CALEPA	January-00
Dibenzo(a,h)anthracene	1.10E-03	$(ug/m^3)^{-1}$	3.9E+00	$(mg/kg/day)^{-1}$	B2	CALEPA	January-00
Fluoranthene	NA		NA		D	IRIS	January-00
Fluorene	NA		NA		D	IRIS	January-00
Indeno(1,2,3-cd)pyrene	1.10E-04	$(ug/m^3)^{-1}$	3.9E-01	$(mg/kg/day)^{-1}$	B2	CALEPA	January-00
Naphthalene	NA		NA		Cannot be determined	IRIS	January-00

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 8
CANCER TOXICITY DATA -- INHALATION
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Unit Risk		Inhalation Cancer Slope Factor (1)		Weight of Evidence/ Cancer Guideline Description	Unit Risk: Inhalation Cancer Slope Factor	
	Value	Units	Value	Units		Source(s)	Date(s)
Phenanthrene	NA		NA		D	IRIS	January-00
Phenol	NA		NA		Inadequate evidence	IRIS	January-00
Pyrene	NA		NA		D	IRIS	January-00
PESTICIDES/PCBs							
Aroclor 1248	5.70E-04	$(ug/m^3)^{-1}$	2.00E+00	$(mg/kg/day)^{-1}$	B2	See PCBs	
Aroclor 1260	5.70E-04	$(ug/m^3)^{-1}$	2.00E+00	$(mg/kg/day)^{-1}$	B2	See PCBs	
INORGANICS/METALS							
Arsenic	4.30E-03	$(ug/m^3)^{-1}$	1.50E+01	$(mg/kg/day)^{-1}$	A	IRIS	January-00
Cyanide	NA		NA		D	IRIS	January-00
Nitrate	ND		ND		ND	IRIS	January-00
Nitrogen, Ammonia	ND		ND		ND	IRIS	January-00

Notes:

In accordance with OSWER 9285.7-53, chronic RfDs are identified from the following heirarchy of sources:

Tier 1:

IRIS = Integrated Risk Information Syste July, 2006

Tier 2:

PPRTV = Preliminary Peer-Reviewed R‹ April, 2006 Obtained from Region III RBC Table

Tier 3:

HEAST= Health Effects Assessment Su FY 1997 Verified using Region IX PRG and/or Region III RBC Table

CALEPA - California Environmental Prot August, 2005

In addition, provisional RfDs developed by NCEA are presented for informational purposes and to be used on a case-by-case basis:

NCEA = National Center for Environmen April, 2006 Obtained from Region III RBC Table

ND = no data available

(1) - Inhalation cancer dose-response values are typically published as unit risk values. Unit risk values may be converted to slope factors using the following equation (HEAST, 1997):

Adjustment = 70 kg [adult body weight] * 1000 ug/mg [conversion factor] / 20 m3/day [inhalation rate]

and: Inhalation Slope Factor = Unit Risk * Adjustment

For slope factors obtained from NCEA (published in USEPA Region III RBC Table), it is assumed that the value has been converted from a Unit Risk value. Therefore, the slope factor is converted back to a unit risk value as follows: 20 m3/day / 70 kg * 1000 ug/mg

PAHs, adjusted by Relative Potency Factors of 1.0 [benzo(a)pyrene, dibenz(a,h)anthracene]; 0.1 [benzo(a)anthracene, benzo(b)flouoranthene, indeno(1,2,3-c,d)pyrene]; 0.01 [benzo(k)fluoranthene]; 0.001 [chrysene].

PCB slope factors are applicable to Aroclors 1016, 1248, 1254, and 1260.

Value for nickel based on nickel as nickel refinery dust

Weight of Evidence:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

mg = milligram

ug = microgram

kg = kilogram

m^3 = cubic meter

BW = body weight

Prepared by: BJR

Checked by: JHP 7/2006

Prepared by: BJR 1/9/07

Checked by: JHP 1/9/07

TABLE 9
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Adjusted Dermal RfD (2)		Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s)
VOLATILES										
Benzene	chronic	4.0E-03	mg/kg/day	100%	4.0E-03	mg/kg/day	Immune system/Decreased lymphocyte count	300	IRIS	July, 2006
	subchronic	4.0E-03	mg/kg/day	100%	4.0E-03	mg/kg/day	Immune system/Decreased lymphocyte count	300	Chronic	
Ethylbenzene	chronic	1.0E-01	mg/kg/day	100%	1.0E-01	mg/kg/day	Liver and kidney/Liver and kidney toxicity	1,000/1	IRIS	July, 2006
	subchronic	1.0E+00	mg/kg/day	100%	1.0E+00	mg/kg/day	Liver and kidney/Liver and kidney toxicity	100/1	HEAST	FY1997
Styrene	chronic	2.0E-01	mg/kg/day	100%	2.0E-01	mg/kg/day	Hemtological and Liver/Red blood cell and liver effects	1,000/1	IRIS	July, 2006
	subchronic	2.0E-01	mg/kg/day	100%	2.0E-01	mg/kg/day	Liver	1,000	MRL	December, 2005
Tetrachloroethene	chronic	1.0E-02	mg/kg/day	100%	1.0E-02	mg/kg/day	Liver/Hepatotoxicity	1,000/1	IRIS	July, 2006
	subchronic	1.0E-01	mg/kg/day	100%	1.0E-01	mg/kg/day	Liver/Hepatotoxicity	100/1	HEAST	FY1997
Toluene	chronic	8.0E-02	mg/kg/day	100%	8.0E-02	mg/kg/day	Kidney/Increased kidney weight	1,000/1	IRIS	July, 2006
	subchronic	2.0E+00	mg/kg/day	100%	2.0E+00	mg/kg/day	Liver and kidneys/Weight change in liver and kidneys	100/1	HEAST	FY1997
Xylenes (total)	chronic	2.0E-01	mg/kg/day	100%	2.0E-01	mg/kg/day	General toxicity/Increased mortality	1,000/1	IRIS	July, 2006
	subchronic	1.0E+00	mg/kg/day	100%	1.0E+00	mg/kg/day	Nervous system/Hyperactivity, decreased body weight	300	MRL	December, 2005
SEMIVOLATILES										
2-Methylnaphthalene	chronic	4.0E-03	mg/kg/day	89%	4.0E-03	mg/kg/day	Lung/pulmonary alveolar proteinosis	1,000/1	IRIS	July, 2006
	subchronic	4.0E-03	mg/kg/day	89%	4.0E-03	mg/kg/day	Lung/pulmonary alveolar proteinosis	1,000/1	Chronic	
Acenaphthene	chronic	6.0E-02	mg/kg/day	89%	6.0E-02	mg/kg/day	Liver/Hepatoxicity	3,000/1	IRIS	July, 2006
	subchronic	6.0E-01	mg/kg/day	89%	6.0E-01	mg/kg/day	Liver/Hepatoxicity	100	MRL	December, 2005
Acenaphthylene	chronic	6.0E-02	mg/kg/day	89%	6.0E-02	mg/kg/day	Liver/Hepatoxicity	3,000/1	Surrogate (1)	
	subchronic	6.0E-01	mg/kg/day	89%	6.0E-01	mg/kg/day	Liver/Hepatoxicity	300/1	Surrogate (1)	
Anthracene	chronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	No effects observed	3,000/1	IRIS	July, 2006
	subchronic	1.0E+00	mg/kg/day	89%	1.0E+00	mg/kg/day	Liver	100	MRL	December, 2005
Benzo(a)anthracene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	Surrogate (2)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	Surrogate (2)	
Benzo(a)pyrene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	Surrogate (2)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	Surrogate (2)	
Benzo(b)fluoranthene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	Surrogate (2)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	Surrogate (2)	
Benzo(g,h,i)perylene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	Surrogate (2)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	Surrogate (2)	
Benzo(k)fluoranthene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	Surrogate (2)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	Surrogate (2)	
Chrysene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	Surrogate (2)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	Surrogate (2)	
Dibenzo(a,h)anthracene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	Surrogate (2)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	Surrogate (2)	
Fluoranthene	chronic	4.0E-02	mg/kg/day	89%	4.0E-02	mg/kg/day	Liver/Increased liver weight; Kidney/nephrotoxicity	3,000/1	IRIS	July, 2006
	subchronic	4.0E-01	mg/kg/day	89%	4.0E-01	mg/kg/day	Liver	300	MRL	December, 2005
Fluorene	chronic	4.0E-02	mg/kg/day	89%	4.0E-02	mg/kg/day	Hematological/decreased red blood cell count	3,000/1	IRIS	July, 2006
	subchronic	4.0E-01	mg/kg/day	89%	4.0E-01	mg/kg/day	Liver	300	MRL	December, 2005
Indeno(1,2,3-cd)pyrene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	Surrogate (2)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	Surrogate (2)	
Naphthalene	chronic	2.0E-02	mg/kg/day	89%	2.0E-02	mg/kg/day	Decreased body weight	3,000/1	IRIS	July, 2006
	subchronic	6.0E-01	mg/kg/day	89%	6.0E-01	mg/kg/day	CNS	90	MRL	December, 2005
Phenanthrene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	Surrogate (2)	
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	Surrogate (2)	

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 9
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Adjusted Dermal RfD (2)		Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfD: Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s)
Phenol	chronic	3.0E-01	mg/kg/day	100%	3.0E-01	mg/kg/day	Reproductive system/decreased maternal weight gain	300/1	IRIS	July, 2006
	subchronic	6.0E-01	mg/kg/day	100%	6.0E-01	mg/kg/day	Developmental/Reduced fetal body weight	100/1	HEAST	FY 1997

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 9
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Adjusted Dermal RfD (2)		Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfD. Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s)
Pyrene	chronic	3.0E-02	mg/kg/day	89%	3.0E-02	mg/kg/day	Kidney/Renal tubluar pathology	3,000/1	IRIS	July, 2006
	subchronic	3.0E-01	mg/kg/day	89%	3.0E-01	mg/kg/day	Kidney/Renal tubluar pathology	300/1	HEAST	FY 1997
PESTICIDES/PCBs										
Aroclor 1248	chronic	2.0E-05	mg/kg/day	80%	2.0E-05	mg/kg/day	Immune system/Immunotoxicity	300/1	Surrogate	
	subchronic	5.0E-05	mg/kg/day	80%	5.0E-05	mg/kg/day	Immune system/Immunotoxicity	300/1	Surrogate	
Aroclor 1260	chronic	2.0E-05	mg/kg/day	80%	2.0E-05	mg/kg/day	Immune system/Immunotoxicity	300/1	Surrogate	
	subchronic	5.0E-05	mg/kg/day	80%	5.0E-05	mg/kg/day	Immune system/Immunotoxicity	300/1	Surrogate	
INORGANICS/METALS										
Arsenic	chronic	3.0E-04	mg/kg/day	95%	3.0E-04	mg/kg/day	Skin/Keratosis and hyperpigmentation	3/1	IRIS	July, 2006
	subchronic	3.0E-04	mg/kg/day	95%	3.0E-04	mg/kg/day	Skin/Keratosis and hyperpigmentation	3/1	HEAST	FY 1997
Cyanide	chronic	2.0E-02	mg/kg/day	>47%	2.0E-02	mg/kg/day	Thyroid, nervous system/thyroid effects; myelin degeneration	100/5	IRIS	July, 2006
	subchronic	5.0E-02	mg/kg/day	>47%	5.0E-02	mg/kg/day	Reproductive	100	MRL	December, 2005
Nitrate	chronic	1.6E+00	mg/kg/day	100%	1.6E+00	mg/kg/day	Hematological/Early clinical signs of methemoglobinemia	1/1	IRIS	July, 2006
	subchronic	1.6E+00	mg/kg/day	100%	1.6E+00	mg/kg/day	Hematological/Early clinical signs of methemoglobinemia	1/1	Chronic	
Nitrogen, Ammonia	chronic	ND							IRIS	July, 2006
	subchronic	ND								

Notes:

In accordance with OSWER 9285.7-53, chronic RfDs are identified from the following heirarchy of sources:

Tier 1:

IRIS = Integrated Risk Information System: July, 2006

Tier 2:

PPRTV = Preliminary Peer-Reviewed Toxicity \ September, Obtained from Region IX PRG Table

April, 2006 Obtained from Region III RBC Table

Tier 3:

HEAST= Health Effects Assessment Summary FY 1997 Verified using Region IX PRG and/or Region III RBC Table

MRL = Minimum Risk Level (ATSDR: chronic M December, 2005

In addition, provisional RfDs developed by NCEA are presented for informational purposes and to be used on a case-by-case basis:

NCEA = National Center for Environmental Ass September, Obtained from Region IX PRG Table

April, 2006 Obtained from Region III RBC Table

Subchronic RfDs are obtained from:

- ATSDR: Intermitent MRLs
- HEAST: subchronic RfDs (from HEAST FY 1997)
- Equal to chronic RfDs when values are not published in HEAST or by ATSDR

mg = milligram

kg = kilogram

surrogate - a value for a closely related chemical is used as the RfD

BW = body weight

chronic - the chronic value is used as the subchronic RfD

ND = no data available

(1) Values obtained from RAGS Volume 1 (Part E, Supplemental Guidance for Dermal Risk Assessment, Interim Guidance) (EPA, 2004)
Per this guidance, a value of 100% is used for analytes without published values.

(2) Adjusted Dermal RfD = Oral RfD x Oral to Dermal Adjustment Factor. Per RAGS Part E (USEPA, 2004), adjustments are only performed for chemicals that have an oral absorption efficiency of less than 50%.

Values for petroleum fractions are provided for informational purposes, and are developed by MADEP.

The RfD for uranium of 6E-04 mg/kg/day was developed by EPA Office of Water in support of the MCL for uranium, and was published in the Federal Register (Thursday, December 7, 2000).

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 9
NON-CANCER TOXICITY DATA -- ORAL/DERMAL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD		Oral Absorption Efficiency for Dermal (1)	Adjusted Dermal RfD (2)		Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfD Target Organ(s)	
		Value	Units		Value	Units			Source(s)	Date(s)

Per USEPA Region I "Risk Updates, No. 5", (August, 1999), Non-carcinogenic PAHs without published RfDs should be evaluated using the published RfD for a structurally similar PAH.

Surrogate (1) - Value for acenaphthene used as a surrogate

Surrogate (2) - Value for pyrene used as a surrogate

RfD for DDT is used as surrogate for DDD and DDE

RfD for Aroclor 1254 used as surrogate for other PCB congeners with no published RfDs

RfD for Endosulfan used as surrogate for other endosulfan compounds

RfD for Endrin used as surrogate for other endrin compounds

For Manganese in drinking water: As recommended by USEPA Region I Risk Update, a non-dietary RfD is obtained by subtracting typical dietary intake of manganese (5 mg/kday) from critical dose (10 mg/day). Non-dietary RfD is then adjusted with a modifying factor of 3, as recommended by IRIS for drinking water exposures.

For manganese in non-drinking water media: As recommended by USEPA Region I Risk Update, a non-dietary RfD is obtained by subtracting typical dietary intake of manganese (5 mg/kday) from critical dose (10 mg/day). A modifying factor of 1 is then applied, per USEPA Region 1.

Value for chlordane used for alpha- and gamma- isomers.

Vanadium - Region 1 - RfD for vanadium is the RfD for Vanadium pentoxide of 9E-3, adjusted for the amount of vanadium in vanadium pentoxide (56%), per USEPA Region I.

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 10
NON-CANCER TOXICITY DATA -- INHALATION
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC (1)		Extrapolated RfD (1)		Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfC. Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s)
VOLATILES									
Benzene	chronic	3.0E-02	mg/m3	8.6E-03	mg/kg/day	Immune system/Decreased lymphocyte count	300/1	IRIS	July, 2006
	subchronic	3.0E-02	mg/m3	8.6E-03	mg/kg/day	Immune system/Decreased lymphocyte count	300/1	Chronic	
Ethylbenzene	chronic	1.0E+00	mg/m3	2.9E-01	mg/kg/day	Developmental/Developmental toxicity	300/1	IRIS	July, 2006
	subchronic	4.4E+00	mg/m3	1.3E+00	mg/kg/day	Developmental	100	MRL	December, 2005
Styrene	chronic	1.0E+00	mg/m3	2.9E-01	mg/kg/day	Nervous System/Neurological effects	30/1	IRIS	July, 2006
	subchronic	3.0E+00	mg/m3	8.6E-01	mg/kg/day	Nervous System/Neurological effects	10	HEAST	FY 1997
Tetrachloroethene	chronic	2.8E-01	mg/m3	8.0E-02	mg/kg/day	Nervous system	100	MRL	December, 2005
	subchronic	2.8E-01	mg/m3	8.0E-02	mg/kg/day	Nervous system		Chronic	
Toluene	chronic	5.0E+00	mg/m3	1.4E+00	mg/kg/day	CNS/Neurological effects	10/1	IRIS	July, 2006
	subchronic	5.0E+00	mg/m3	1.4E+00	mg/kg/day	CNS/Neurological effects	10/1	Chronic	
Xylenes (total)	chronic	1.0E-01	mg/m3	2.9E-02	mg/kg/day	CNS/Impaired motor coordination	300/1	IRIS	July, 2006
	subchronic	7.9E+00	mg/m3	2.3E+00	mg/kg/day	Nervous system	90	MRL	December, 2005
SEMIVOLATILES									
2-Methylnaphthalene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Acenaphthene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Acenaphthylene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Anthracene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Benzo(a)anthracene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Benzo(a)pyrene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Benzo(b)fluoranthene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Benzo(g,h,i)perylene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Benzo(k)fluoranthene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Chrysene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Dibenzo(a,h)anthracene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Fluoranthene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Fluorene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Indeno(1,2,3-cd)pyrene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 10
NON-CANCER TOXICITY DATA -- INHALATION
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC (1) Value	Inhalation RfC (1) Units	Extrapolated RfD (1) Value	Extrapolated RfD (1) Units	Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfC: Target Organ(s) Source(s)	RfC: Target Organ(s) Date(s)
Naphthalene	chronic	3.0E-03	mg/m3	8.6E-04	mg/kg/day	Lung/Hyperplasia and metaplasia of epithelial cells	3,000/1	IRIS	July, 2006
	subchronic	3.0E-03	mg/m3	8.6E-04	mg/kg/day	Lung/Hyperplasia and metaplasia of epithelial cells	3,000/1	IRIS	July, 2006
Phenanthrene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Phenol	chronic	2.0E-01	mg/m3	5.7E-02	mg/kg/day	Liver, CNS, Kidney		REL	February, 2005
	subchronic	2.0E-01	mg/m3	5.7E-02	mg/kg/day	Liver, CNS, Kidney		Chronic	
Pyrene	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
PESTICIDES/PCBs									
Aroclor 1248	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Aroclor 1260	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
INORGANICS/METALS									
Arsenic	chronic	3.0E-05	mg/m3	8.6E-06	mg/kg/day	Developmenta/Cardiovascular/CNS		REL	February, 2005
	subchronic	ND		ND					
Cyanide	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Nitrate	chronic	ND		ND				IRIS	July, 2006
	subchronic	ND		ND					
Nitrogen, Ammonia	chronic	1.0E-01	mg/m3	2.9E-02	mg/kg/day	Respiratory system/Chemical pneumonia	30/1	IRIS	July, 2006
	subchronic	1.0E-01	mg/m3	2.9E-02	mg/kg/day	Respiratory system/Chemical pneumonia	30/1	Chronic	

Notes:

In accordance with OSWER 9285.7-53, chronic RfDs are identified from the following heirarchy of sources:

Tier 1:

IRIS = Integrated Risk Information System: July, 2006

Tier 2:

PPRTV = Preliminary Peer-Reviewed Toxicity \ September, Obtained from Region IX PRG Table

April, 2006 Obtained from Region III RBC Table

Tier 3:

HEAST= Health Effects Assessment Summary FY 1997 Verified using Region IX PRG and/or Region III RBC Table

MRL = Minimum Risk Level (ATSDR: chronic N December, 2005

REL - CALEPA February, 2005

In addition, provisional RfDs developed by NCEA are presented for informational purposes and to be used on a case-by-case basis:

NCEA = National Center for Environmental Ass September, Obtained from Region IX PRG Table

April, 2006 Obtained from Region III RBC Table

Subchronic RfDs are obtained from:

- ATSDR: Intermitent MRLs
- HEAST: subchronic RfDs (from HEAST FY 1997)
- Equal to chronic RfDs when values are not published in HEAST or by ATSDR

chronic - the chronic value is used as the subchronic RfD

mg = milligram
kg = kilogram
ug - microgram
m^3 - cubic meter
BW = body weight

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 10
NON-CANCER TOXICITY DATA -- INHALATION
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern	Chronic/ Subchronic	Inhalation RfC (1)		Extrapolated RfD (1)		Primary Target Organ or System / Critical Effect	Combined Uncertainty/Modifying Factors	RfC: Target Organ(s)	
		Value	Units	Value	Units			Source(s)	Date(s)

Values for petroleum fractions are provided for informational purposes, and are developed by MADEP.

(1) - Inhalation non-cancer dose-response values are typically published as RfC values. RfC values may be converted to RfDs using the following equation (HEAST, 1997):
RfD (mg/kg-d) = RfC (mg/m^3) x 20 m^3/d / 70 kg, unless otherwise indicated

For RfDs obtained from NCEA (published in USEPA Region III RBC Table), it is assumed that the value has been converted from a RfC value. Therefore, the RfD is converted back to a RfC value as follows: RfC (mg/m^3) = RfD (mg/kg/day) x 70 kg / 20 m^3/day

The value for chlordane is used as surrogate for the isomers.

Value for chromium VI particulates; value for chromium VI as dissolved chromium VI aerosols or chromic acid mists is 8E-6 mg/m3

There is a National Ambient Air Quality Standard for lead of 1.5 μg/m3 averaged over three months

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 11
RISK SUMMARY - CURRENT LAND USE
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Exposure Scenario	Exposure Point	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Current					
Trespasser	Surface Soil - River Parcel	Adolescent (ages 10-18)	Incidental ingestion	1.9.E-04	0.055
			Dermal contact	1.8.E-04	0.048
			Total Surface Soil Risk:	**4.E-04**	**0.1**
	Ambient Air		Inhalation	2.8.E-09	0.0035
			Total Ambient Air Risk:	**3E-09**	**0.003**
			Total Receptor Risk:	**4E-04**	**0.1**

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 12
RISK SUMMARY - FUTURE RECREATIONAL LAND USE
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Exposure Scenario	Exposure Point	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Future					
Recreational Visitor	Surface Soil - Main Parcel	Child (ages 1-6)	Incidental ingestion	5.4E-04	1.3
			Dermal contact	2.0E-04	0.48
			Dust inhalation	3.6E-11	0.00000068
			Total Risk:	**7E-04**	**2**
		Adult	Incidental ingestion	2.3E-04	0.14
			Dermal contact	1.2E-04	0.073
			Dust inhalation	1.5E-10	0.00000068
			Total Risk:	**4E-04**	**0.2**
			Total Receptor Risk - Surface Soil - Main Parcel:	**1E-03**	**2**
Recreational Visitor	Surface Soil - River Parcel	Child (ages 1-6)	Incidental ingestion	2.6E-03	1.0
			Dermal contact	9.4E-04	0.34
			Dust inhalation	1.6E-10	0.00000038
			Total Risk:	**4E-03**	**1**
		Adult	Incidental ingestion	1.1E-03	0.11
			Dermal contact	5.8E-04	0.053
			Dust inhalation	6.6E-10	0.00000038
			Total Risk:	**2E-03**	**0.2**
			Total Receptor Risk - Surface Soil - River Parcel:	**5E-03**	**1**
Recreational Visitor	Sediment	Child (ages 1-6)	Dermal contact	2.4E-06	0.0025
			Total Risk:	**2E-06**	**0.003**
		Adult	Dermal contact	7.0E-06	0.0016
			Total Risk:	**7E-06**	**0.002**
			Total Receptor Risk - Sediment:	**9E-06**	**0.003**
Recreational Visitor	Surface water	Child (ages 1-6)	Incidental ingestion	4.9E-08	0.00049
			Dermal contact	1.0E-05	0.0014
			Total Risk:	**1E-05**	**0.002**
		Adult	Incidental ingestion	3.9E-08	0.00011
			Dermal contact	2.4E-05	0.00085
			Total Risk:	**2E-05**	**0.001**
			Total Receptor Risk - Surface Water:	**3E-05**	**0.002**
Recreational Visitor	Ambient Air	Child (ages 1-6)	Inhalation	5.8E-09	0.029
			Total Risk:	**6E-09**	**0.03**
		Adult	Inhalation	2.0E-08	0.029
			Total Risk:	**2E-08**	**0.03**
			Total Receptor Risk - Ambient Air:	**3E-08**	**0.03**
Total Receptor Risk - Main Parcel, Surface Water, Sediment, and Air:				**1E-03**	**2**
Total Receptor Risk - River Parcel, Surface Water, Sediment, and Air:				**5E-03**	**1**

Total Receptor Risk: Cancer risk is the sum of risks among all age groups evaluated; hazard index is the highest hazard index among all age groups evaluated.

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 13
RISK SUMMARY - FUTURE COMMERCIAL/INDUSTRIAL USE
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Exposure Scenario	Exposure Point	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Future					
Commercial/Industrial Indoor Woker	Surface soil - Main Parcel	Adult - Indoor Worker	Incidental ingestion	4.2E-04	0.24
			Total Surface Soil Risk:	**4E-04**	**0.2**
	Groundwater	Adult - Indoor Worker	Ingestion	9.1E-04	6.6
			Total Groundwater Risk:	**9E-04**	**7**
	Indoor air - Vapor intrustion	Adult - Indoor Worker	Inhalation	2.0E-05	0.31
			Total Indoor Air Risk:	**2E-05**	**0.3**
Total Receptor Risk Indoor Commercial/Industrial Worker - Main Parcel, Groundwater, Indoor Air:				**1E-03**	**7**
Commercial/Industrial Outdoor Woker	Surface soil - Main Parcel	Adult - Outdoor Worker	Incidental ingestion	7.6E-04	0.44
			Dermal contact	6.5E-04	0.38
			Dust inhalation	1.9E-09	0.0000085
			Total Surface Soil - Main Parcel Receptor Risk:	**1.E-03**	**0.8**
	Surface Soil - River Parcel	Adult - Outdoor Worker	Incidental ingestion	3.6E-03	0.34
			Dermal contact	3.1E-03	0.27
			Dust inhalation	8.6E-09	0.0000048
			Total Surface Soil - River Parcel Receptor Risk:	**7.E-03**	**0.6**
	Groundwater	Adult - Outdoor Worker	Incidental ingestion	9.1E-04	6.6
			Total Groundwater Risk:	**9.E-04**	**7**
	Ambient Air	Adult - Outdoor Worker	Inhalation	3.0E-07	0.36
			Total Ambient Air Risk:	**3.E-07**	**0.4**
Total Receptor Risk - Outdoor Commercial Industrial Worker - Main Parcel, Groundwater, Outdoor Air:				**2E-03**	**8**
Total Receptor Risk - Outdoor Commercial Industrial Worker - River Parcel, Groundwater, Outdoor Air:				**8E-03**	**8**

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 14
RISK SUMMARY - FUTURE CONSTRUCTION WORKER
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Exposure Scenario	Receptor	Exposure Point	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Future					
Construction Worker	Adult	Ambient Air	Inhalation	4.0E-03	1200
			Total Ambient Air Risk:	**4.E-03**	**1200**
		Surface soil - Main Parcel	Incidental ingestion	1.1E-04	0.72
			Dermal contact	2.9E-05	0.18
			Dust inhalation	8.4E-09	0.00062
			Total Receptor Risk - Surface Soil - Main Parcel:	**1E-04**	**0.9**
			Total Receptor Risk - Surface Soil - Main Parcel, Ambient Air:	**4.E-03**	**1201**
		Subsurface soil - Main Parcel	Incidental ingestion	8.5E-04	0.44
			Dermal contact	2.2E-04	0.097
			Dust inhalation	6.0E-08	0.00084
			Total Receptor Risk - Subsurface Soil - Main Parcel:	**1E-03**	**0.5**
			Total Receptor Risk - Subsurface Soil - Main Parcel, Ambient Air:	**5.E-03**	**1201**
		Surface Soil - River Parcel	Incidental ingestion	5.3E-04	0.25
			Dermal contact	1.4E-04	0.042
			Dust inhalation	3.8E-08	0.000018
			Total Receptor Risk - Surface Soil - River Parcel:	**7E-04**	**0.3**
			Total Receptor Risk - Surface Soil - River Parcel, Ambient Air:	**5.E-03**	**1200**
		Subsurface Soil - River Parcel	Incidental ingestion	6.5E-07	0.097
			Dermal contact	4.4E-08	0.0058
			Dust inhalation	8.3E-10	0.000000027
			Total Receptor Risk - Subsurface Soil - River Parcel:	**7E-07**	**0.1**
			Total Receptor Risk - Subsurface Soil - River Parcel, Ambient Air:	**4.E-03**	**1200**

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 15
RISK SUMMARY - FUTURE RECREATIONAL LAND USE - SUBSURFACE SOIL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Exposure Scenario	Exposure Point	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Future					
Recreational Visitor	Subsurface Soil - Main Parcel	Child (ages 1-6)	Incidental ingestion	4.1E-03	1.8
			Dermal contact	1.5E-03	0.65
			Dust inhalation	2.6E-10	0.000000084
			Total Risk:	**6E-03**	**2**
		Adult	Incidental ingestion	1.8E-03	0.20
			Dermal contact	9.2E-04	0.10
			Dust inhalation	1.0E-09	0.000000084
			Total Risk:	**3E-03**	**0.3**
			Total Receptor Risk - Subsurface Soil - Main Parcel:	**8E-03**	**2**
Recreational Visitor	Subsurface Soil - River Parcel	Child (ages 1-6)	Incidental ingestion	3.2E-06	0.079
			Dermal contact	3.0E-07	0.0066
			Dust inhalation	3.6E-12	0.00000032
			Total Risk:	**4E-06**	**0.09**
		Adult	Incidental ingestion	1.4E-06	0.0085
			Dermal contact	1.8E-07	0.0010
			Dust inhalation	1.4E-11	0.0000003
			Total Risk:	**2E-06**	**0.009**
			Total Receptor Risk - Subsurface Soil - River Parcel:	**5E-06**	**0.09**
Recreational Visitor	Sediment	Child (ages 1-6)	Dermal contact	2.4E-06	0.0025
			Total Risk:	**2E-06**	**0.003**
		Adult	Dermal contact	7.0E-06	0.0016
			Total Risk:	**7E-06**	**0.002**
			Total Receptor Risk - Sediment:	**9E-06**	**0.003**
Recreational Visitor	Surface water	Child (ages 1-6)	Incidental ingestion	4.9E-08	0.00049
			Dermal contact	1.0E-05	0.0014
			Total Risk:	**1E-05**	**0.002**
		Adult	Incidental ingestion	3.9E-08	0.00011
			Dermal contact	2.4E-05	0.00085
			Total Risk:	**2E-05**	**0.001**
			Total Receptor Risk - Surface Water:	**3E-05**	**0.002**
Recreational Visitor	Ambient Air	Child (ages 1-6)	Inhalation	5.8E-09	0.029
			Total Risk:	**6E-09**	**0.03**
		Adult	Inhalation	2.0E-08	0.029
			Total Risk:	**2E-08**	**0.03**
			Total Receptor Risk - Ambient Air:	**3E-08**	**0.03**
Total Receptor Risk - Main Parcel, Surface Water, Sediment, and Air:				**8E-03**	**2**
Total Receptor Risk - River Parcel, Surface Water, Sediment, and Air:				**5E-05**	**0.1**

Total Receptor Risk: Cancer risk is the sum of risks among all age groups evaluated; hazard index is the highest hazard index among all age groups evaluated.

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 16
RISK SUMMARY - FUTURE COMMERCIAL/INDUSTRIAL USE - SUBSURFACE SOIL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Exposure Scenario	Exposure Point	Receptor	Exposure Route	Excess Lifetime Cancer Risk	Hazard Index
Future					
Commercial/Industrial Indoor Worker	Subsurface soil - Main Parcel	Adult - Indoor Worker	Incidental ingestion	3.2E-03	0.34
			Total Surface Soil Risk:	**3E-03**	**0.3**
	Groundwater	Adult - Indoor Worker	Incidental ingestion	9.1E-04	6.6
			Total Groundwater Risk:	**9E-04**	**7**
	Indoor air - Vapor intrustion	Adult - Indoor Worker	Inhalation	2.0E-05	0.31
			Total Indoor Air Risk:	**2E-05**	**0.3**
Total Receptor Risk Indoor Commercial/Industrial Worker - Main Parcel, Groundwater, Indoor Air:				**4E-03**	**7**
Commercial/Industrial Outdoor Worker	Subsurface soil - Main Parcel	Adult - Outdoor Worker	Incidental ingestion	5.8E-03	0.62
			Dermal contact	4.9E-03	0.52
			Dust inhalation	1.3E-08	0.000010
			Total Surface Soil - Main Parcel Receptor Risk:	**1.E-02**	**1**
	Subsurface Soil - River Parcel	Adult - Outdoor Worker	Incidental ingestion	4.4E-06	0.026
			Dermal contact	9.9E-07	0.0053
			Dust inhalation	1.9E-10	0.0000041
			Total Surface Soil - River Parcel Receptor Risk:	**5.E-06**	**0.03**
	Groundwater	Adult - Outdoor Worker	Incidental ingestion	9.1E-04	6.6
			Total Groundwater Risk:	**9.E-04**	**7**
	Ambient Air	Adult - Outdoor Worker	Inhalation	3.0E-07	0.36
			Total Ambient Air Risk:	**3.E-07**	**0.4**
Total Receptor Risk - Outdoor Commercial Industrial Worker - Main Parcel, Groundwater, Outdoor Air:				**1E-02**	**8**
Total Receptor Risk - Outdoor Commercial Industrial Worker - River Parcel, Groundwater, Outdoor Air:				**9E-04**	**7**

Prepared by: BJR 1/9/07
Checked by: JHP 1/9/07

TABLE 17
SELECTION OF CHEMICALS OF CONCERN - SURFACE SOIL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Arithmetic Mean (2)	Sample ID of Maximum Concentration	Background (3)	Selected Benchmark (4)	Selected as COPC? (5)	Rationale
	Volatile Organics (mg/kg)									
71-55-6	1,1,1-Trichloroethane	0 / 18	0.007 - 5.6		0.18				No	ND
79-34-5	1,1,2,2-Tetrachloroethane	0 / 18	0.007 - 5.6		0.18				No	ND
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	0 / 18	0.007 - 5.6		0.18				No	ND
79-00-5	1,1,2-Trichloroethane	0 / 18	0.007 - 5.6		0.18				No	ND
75-34-3	1,1-Dichloroethane	0 / 18	0.007 - 5.6		0.18				No	ND
75-35-4	1,1-Dichloroethene	0 / 18	0.007 - 5.6		0.18				No	ND
120-82-1	1,2,4-Trichlorobenzene	0 / 18	0.007 - 5.6		0.18				No	ND
96-12-8	1,2-Dibromo-3-chloropropane (DBCP)	0 / 18	0.007 - 5.6		0.18				No	ND
106-93-4	1,2-Dibromoethane (EDB)	0 / 18	0.007 - 5.6		0.18				No	ND
95-50-1	1,2-Dichlorobenzene	0 / 18	0.007 - 5.6		0.18				No	ND
107-06-2	1,2-Dichloroethane	0 / 18	0.007 - 5.6		0.18				No	ND
78-87-5	1,2-Dichloropropane	0 / 18	0.007 - 5.6		0.18				No	ND
541-73-1	1,3-Dichlorobenzene	0 / 18	0.007 - 5.6		0.18				No	ND
106-46-7	1,4-Dichlorobenzene	0 / 18	0.007 - 5.6		0.18				No	ND
78-93-3	2-Butanone (MEK)	8 / 18	0.008 - 5.6	0.002 - 0.15	0.20	OU3-SSMW-36_0-3_110104		89.6	No	BSL
591-78-6	2-Hexanone	0 / 18	0.007 - 5.6		0.18				No	ND
108-10-1	4-Methyl-2-pentanone	0 / 18	0.007 - 5.6		0.18				No	ND
67-64-1	Acetone	14 / 18	0.009 - 5.6	0.013 - 0.37	0.27	OU3-SSMW-36_0-3_110104		2.5	No	BSL
71-43-2	Benzene	35 / 84	0.007 - 0.36	0.0071 - 7.6	0.24	OU3-SSTPB-03_0-3_110904		0.255	Yes	ASL
75-27-4	Bromodichloromethane	0 / 18	0.007 - 5.6		0.18				No	ND
75-25-2	Bromoform	0 / 18	0.007 - 5.6		0.18				No	ND
74-83-9	Bromomethane (Methyl bromide)	1 / 18	0.007 - 5.6	0.0008 - 0.0008	0.18	OU3-SSTPB-09_0-3_111004		0.235	No	BSL
75-15-0	Carbon disulfide	6 / 18	0.007 - 5.6	0.001 - 0.011	0.18	OU3-SSMW-38_0-3_110104		0.094	No	BSL
56-23-5	Carbon Tetrachloride	0 / 18	0.007 - 5.6		0.18				No	ND
108-90-7	Chlorobenzene	0 / 18	0.007 - 5.6		0.18				No	ND
75-00-3	Chloroethane	0 / 18	0.007 - 5.6		0.18				No	ND
67-66-3	Chloroform	0 / 18	0.007 - 5.6		0.18				No	ND
74-87-3	Chloromethane (Methyl chloride)	0 / 18	0.007 - 5.6		0.18				No	ND
156-59-2	cis-1,2-Dichloroethene	0 / 18	0.007 - 5.6		0.18				No	ND
10061-01-5	cis-1,3-Dichloropropene	0 / 18	0.007 - 5.6		0.18				No	ND
110-82-7	Cyclohexane	7 / 18	0.007 - 5.6	0.0008 - 0.003	0.18	OU3-SSMW-40_0-3_110304		0.1	No	BSL
124-48-1	Dibromochloromethane	0 / 18	0.007 - 5.6		0.18				No	ND
75-71-8	Dichlorodifluoromethane	0 / 18	0.007 - 5.6		0.18				No	ND
100-41-4	Ethylbenzene	40 / 84	0.007 - 0.36	0.0008 - 29	0.53	OU3-SSTPB-03_0-3_110904		5.16	Yes	ASL
98-82-8	Isopropylbenzene	1 / 18	0.007 - 0.87	2.8 - 2.8	0.18	OU3-SSTPB-03_0-3_110904		40	No	BSL
79-20-9	Methyl Acetate	15 / 18	0.009 - 5.6	0.0009 - 0.22	0.18	OU3-SS-TPB-01_0-3_110804		0.24	No	BSL
1634-04-4	Methyl tertiary butyl ether (MTBE)	0 / 18	0.007 - 5.6		0.18				No	ND
108-87-2	Methylcyclohexane	5 / 18	0.007 - 5.6	0.001 - 0.01	0.18	OU3-SSMW-37_110104		39	No	BSL
75-09-2	Methylene Chloride	6 / 18	0.008 - 5.6	0.002 - 0.004	0.18	OU3-SBTPB-05_19-21_110904		4.05	No	BSL
100-42-5	Styrene	9 / 84	0.007 - 0.36	0.042 - 26	0.60	OU3-SSTPB-03_0-3_110904		4.69	Yes	ASL
127-18-4	Tetrachloroethene	0 / 18	0.007 - 5.6		0.18				No	ND
108-88-3	Toluene	30 / 84	0.007 - 0.36	0.001 - 25	0.54	OU3-SSTPB-03_0-3_110904		5.45	Yes	ASL

TABLE 17
SELECTION OF CHEMICALS OF CONCERN - SURFACE SOIL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Arithmetic Mean (2)	Sample ID of Maximum Concentration	Background (3)	Selected Benchmark (4)	Selected as COPC? (5)	Rationale
156-60-5	trans-1,2-Dichloroethene	0 / 18	0.007 - 5.6		0.18				No	ND
10061-02-6	trans-1,3-Dichloropropene	0 / 18	0.007 - 5.6		0.18				No	ND
79-01-6	Trichloroethene	0 / 18	0.007 - 5.6		0.18				No	ND
75-69-4	Trichlorofluoromethane	0 / 18	0.007 - 5.6		0.18				No	ND
75-01-4	Vinyl Chloride	0 / 18	0.007 - 5.6		0.18				No	ND
1330-20-7	Xylenes (total)	52 / 84	0.007 - 0.72	0.0007 - 130	2.2	OU3-SSTPB-03_0-3_110904		10	Yes	ASL
	Semivolatile Organics (mg/kg)									
90-12-0	1-Methylnaphthalene	8 / 18	0.0072 - 0.98	0.011 - 370	21	OU3-SSTPB-03_0-3_110904		3.24	Yes	ASL
91-57-6	2-Methylnaphthalene	70 / 84	0.0072 - 31	0.0031 - 820	52	OU3-SSTPB-03_0-3_110904		3.24	Yes	ASL
83-32-9	Acenaphthene	80 / 84	0.0072 - 0.0087	0.0084 - 1100	82	OU3-DPS-102-002		682	Yes	ASL
208-96-8	Acenaphthylene	55 / 84	0.0072 - 72	0.0038 - 220	6.9	OU3-DPS-102-002		682	No	BSL
120-12-7	Anthracene	80 / 84	0.0000072 - 0.0000087	0.012 - 4300	130	OU3-DPS43-0003		1480	Yes	ASL
56-55-3	Benzo(a)anthracene	81 / 84	0.0072 - 0.0078	0.02 - 2000	116	OU3-DPS96-0002		5 21	Yes	ASL
50-32-8	Benzo(a)pyrene	81 / 84	0.0072 - 0 0078	0 015 - 2400	134	OU3-DPS96-0002		1 52	Yes	ASL
205-99-2	Benzo(b)fluoranthene	81 / 84	0.0072 - 0.0078	0.026 - 2100	131	OU3-DPS37-0003		59 8	Yes	ASL
191-24-2	Benzo(ghi)perylene	77 / 84	0.0072 - 19	0.047 - 2100	106	OU3-DPS96-0002		119	Yes	ASL
207-08-9	Benzo(k)fluoranthene	79 / 84	0.0072 - 0.079	0.027 - 1700	76	OU3-DPS96-0002		148	Yes	ASL
117-81-7	bis(2-Ethylhexyl) phthalate	0 / 2	3.8 - 75		20				No	ND
85-68-7	Butyl benzyl phthalate	0 / 2	3.8 - 75		20				No	ND
218-01-9	Chrysene	81 / 84	0.0072 - 0.0078	0.024 - 2100	122	OU3-DPS96-0002		4.73	Yes	ASL
53-70-3	Dibenzo(a,h)anthracene	76 / 84	0.0072 - 19	0.015 - 630	28	OU3-DPS96-0002		18.4	Yes	ASL
84-66-2	Diethyl phthalate	0 / 2	3.8 - 75		20				No	ND
131-11-3	Dimethyl phthalate	0 / 2	3.8 - 75		20				No	ND
84-74-2	Di-n-butyl phthalate	0 / 2	3.8 - 75		20				No	ND
117-84-0	Di-n-octyl phthalate	0 / 2	3.8 - 75		20				No	ND
206-44-0	Fluoranthene	82 / 84	0.0072 - 0.0078	0.055 - 3900	277	OU3-DPS-102-002		122	Yes	ASL
86-73-7	Fluorene	78 / 84	0.0072 - 0.0087	0.0048 - 920	66	OU3-DPS-102-002		122	Yes	ASL
193-39-5	Indeno(1,2,3-cd)pyrene	77 / 84	0.0072 - 19	0.036 - 1900	92	OU3-DPS96-0002		109	Yes	ASL
91-20-3	Naphthalene	81 / 84	0.0078 - 1.7	0.0053 - 11000	278	OU3-DPS-102-002		0.099	Yes	ASL
85-01-8	Phenanthrene	82 / 84	0.0072 - 0.0078	0.043 - 3800	236	OU3-DPS-102-002		46	Yes	ASL
129-00-0	Pyrene	82 / 84	0.0072 - 0.0078	0.038 - 2900	186	OU3-DPS96-0002		78.5	Yes	ASL
TotalPhenol	Total Phenols	38 / 74	1.1 - 5.9	0.08 - 170	5.5	OU3-DPS57-0003		122	Yes	ASL
	PCBs (mg/kg)									
12674-11-2	Aroclor 1016	0 / 18	0.037 - 1.9		0.15				No	ND
11104-28-2	Aroclor 1221	0 / 18	0.037 - 1.9		0.15				No	ND
11141-16-5	Aroclor 1232	0 / 18	0.037 - 1.9		0.15				No	ND
53469-21-9	Aroclor 1242	0 / 18	0.037 - 1.9		0.15				No	ND
12672-29-6	Aroclor 1248	8 / 18	0.037 - 1.9	0.024 - 4.8	0.41	OU3-SS75-0006		0.00033	Yes	ASL
11097-69-1	Aroclor 1254	0 / 18	0.037 - 1.9		0.15				No	ND
11096-82-5	Aroclor 1260	17 / 18	0.04 - 0.04	0.014 - 6.5	0.96	OU3-SS78-0006		0 00033	Yes	ASL
	Inorganics (mg/kg)									
7440-38-2	Arsenic	73 / 73		2.3 - 18.7	6.8	OU3-SSMW-38_0-3_110104		18	Yes	ASL
FREE-CN	Cyanide (Free)	0 / 16	0.54 - 0.73		0.30				No	ND

TABLE 17
SELECTION OF CHEMICALS OF CONCERN - SURFACE SOIL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Arithmetic Mean (2)	Sample ID of Maximum Concentration	Background (3)	Selected Benchmark (4)	Selected as COPC? (5)	Rationale
57-12-5	Cyanide, Total	10 / 59	0.55 - 2.9	0.56 - 14	0.82	OU3-DPS57-0003		1.3	Yes	ASL
NO3N	Nitrate as N	0 / 1	5.8 - 5.8		2.9				No	ND
NH3N	Nitrogen, as Ammonia	47 / 73	0.2 - 2.5	0.09 - 56	3.9	OU3-DPS34-0003		73.5	No	BSL

(1) Samples and data used in this summary are provided in Appendix F.
(2) Arithmetic mean concentration is the arithmetic mean calculated using 1/2 the detection limit for non-detects.
(3) Surface soil background data not available.
(4) Surface soil screening values are provided in Table 8.14.
(5) Parameter is selected as a Chemical of Potential Concern (COPC) if the maximum detected concentration is greater than the selected benchmark (or if a screening level is not available) unless the frequency of detection for that parameter is less than 5 %.
ASL - Maximum detected concentration is above screening level.
BSL - Maximum detected concentration is below screening level
FOD - Frequency of detection less than 5%.
ND - Not detected.
NSL - No screening level available.
NA - Not applicable
mg/kg- milligrams per kilograms

TABLE 18
SELECTION OF CHEMICALS OF CONCERN - SURFACE WATER
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Sample ID of Maximum Concentration	Arithmetic Mean (2)	Surface Water Background (3)		Selected Benchmark (4)	Selected as COPC? (5)	Rationale
							Maximum	Average			
	Volatile Organics (mg/L)										
71-55-6	1,1,1-Trichloroethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
79-34-5	1,1,2,2-Tetrachloroethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	1 / 15	0.0005 - 0.0005	0.00012 - 0.00012	OU3-SW-08-111604	0.00024		0.00025		Yes	NSL
79-00-5	1,1,2-Trichloroethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
75-34-3	1,1-Dichloroethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
75-35-4	1,1-Dichloroethene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
120-82-1	1,2,4-Trichlorobenzene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
96-12-8	1,2-Dibromo-3-chloropropane (DBCP)	0 / 0								No	ND
106-93-4	1,2-Dibromoethane (EDB)	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
95-50-1	1,2-Dichlorobenzene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
107-06-2	1,2-Dichloroethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
78-87-5	1,2-Dichloropropane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
541-73-1	1,3-Dichlorobenzene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
106-46-7	1,4-Dichlorobenzene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
78-93-3	2-Butanone (MEK)	0 / 0								No	ND
591-78-6	2-Hexanone	0 / 15	0.005 - 0.005			0.0025		0.0025		No	ND
108-10-1	4-Methyl-2-pentanone	0 / 15	0.005 - 0.005			0.0025		0.0025		No	ND
67-64-1	Acetone	0 / 0								No	ND
71-43-2	Benzene	0 / 28	0.0005 - 0.001			0.00037		0.00035		No	ND
74-97-5	Bromochloromethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
75-27-4	Bromodichloromethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
75-25-2	Bromoform	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
74-83-9	Bromomethane (Methyl bromide)	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
75-15-0	Carbon disulfide	1 / 15	0.0005 - 0.0005	0.00013 - 0.00013	OU3-SW-08-111604	0.00024		0.00025	0.015	No	BSL
56-23-5	Carbon Tetrachloride	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
108-90-7	Chlorobenzene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
75-00-3	Chloroethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
67-66-3	Chloroform	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
74-87-3	Chloromethane (Methyl chloride)	1 / 15	0.0005 - 0.0005	0.0026 - 0.0026	OU3-SW-08-111604	0.00041		0.00025	5.5	No	BSL
156-59-2	cis-1,2-Dichloroethene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
10061-01-5	cis-1,3-Dichloropropene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
110-82-7	Cyclohexane	1 / 15	0.0005 - 0.0005	0.00012 - 0.00012	OU3-SW-06-111604	0.00024		0.00025		Yes	NSL
124-48-1	Dibromochloromethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
75-71-8	Dichlorodifluoromethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
100-41-4	Ethylbenzene	0 / 28	0.0005 - 0.001			0.00037		0.00035		No	ND
98-82-8	Isopropylbenzene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
79-20-9	Methyl Acetate	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
1634-04-4	Methyl tertiary butyl ether (MTBE)	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
108-87-2	Methylcyclohexane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
75-09-2	Methylene Chloride	1 / 15	0.0005 - 0.0005	0.0001 - 0.0001	OU3-SW-02-111504	0.00024		0.00025	1.9	No	BSL
100-42-5	Styrene	0 / 28	0.0005 - 0.001			0.00037		0.00035		No	ND
127-18-4	Tetrachloroethene	1 / 15	0.0005 - 0.0005	0.00017 - 0.00017	OU3-SW-08-111604	0.00024		0.00025	0.053	No	BSL
108-88-3	Toluene	0 / 28	0.0005 - 0.001			0.00037		0.00035		No	ND
156-60-5	trans-1,2-Dichloroethene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
10061-02-6	trans-1,3-Dichloropropene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
79-01-6	Trichloroethene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
75-69-4	Trichlorofluoromethane	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND

TABLE 18
SELECTION OF CHEMICALS OF CONCERN - SURFACE WATER
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Sample ID of Maximum Concentration	Arithmetic Mean (2)	Surface Water Background (3) Maximum	Surface Water Background (3) Average	Selected Benchmark (4)	Selected as COPC? (5)	Rationale
75-01-4	Vinyl Chloride	0 / 15	0.0005 - 0.0005			0.00025		0 00025		No	ND

TABLE 18
SELECTION OF CHEMICALS OF CONCERN - SURFACE WATER
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Sample ID of Maximum Concentration	Arithmetic Mean (2)	*Surface Water Background (3)* Maximum	Average	Selected Benchmark (4)	Selected as COPC? (5)	Rationale
1330-20-7	Xylenes (total)	1 / 28	0.0005 - 0.002	0.00013 - 0.00013	OU3-SW-08-111604	0.00059		0.00055	0.027	No	BSL
	Semivolatile Organics (mg/L)										
87-61-6	1,2,3-Trichlorobenzene	0 / 15	0.0005 - 0.0005			0.00025		0.00025		No	ND
90-12-0	1-Methylnaphthalene	0 / 15	0.0002 - 0.0002			0.00010		0.00010		No	ND
91-57-6	2-Methylnaphthalene	8 / 28	0.0002 - 0.0002	0.000029 - 0.000089	OU3-SW27-0000	0.000083		0.00010	0.07	No	BSL
83-32-9	Acenaphthene	9 / 28	0.0002 - 0.0002	0.000042 - 0.0016	OU3-SW38-0000	0.00014		0.00010	0.015	No	BSL
208-96-8	Acenaphthylene	1 / 28	0.00019 - 0.00021	0.00015 - 0.00015	OU3-SW38-0000	0.00010		0.00010		No	FOD
120-12-7	Anthracene	1 / 28	0.00019 - 0.00021	0.00061 - 0.00061	OU3-SW38-0000	0.00012		0.00010	0.000020	No	FOD
56-55-3	Benzo(a)anthracene	7 / 28	0.00019 - 0.00021	0.000023 - 0.00066	OU3-SW-10-111604	0.00012	0.000046	0.000081	0.000027	Yes	ASL
50-32-8	Benzo(a)pyrene	2 / 28	0.00019 - 0.00021	0.00011 - 0.00044	OU3-SW-10-111604	0.00011		0.00010	0.000014	Yes	ASL
205-99-2	Benzo(b)fluoranthene	5 / 28	0.00019 - 0.00021	0.000049 - 0.00043	OU3-SW-10-111604	0.00011	0.000088	0.00010	0.00042	Yes	ASL
191-24-2	Benzo(ghi)perylene	0 / 28	0.00019 - 0.00021			0.00010		0.00010	0.00014	No	ND
207-08-9	Benzo(k)fluoranthene	2 / 28	0.00019 - 0.00021	0.00011 - 0.00043	OU3-SW-10-111604	0.00011		0.00010	0.00014	Yes	ASL
218-01-9	Chrysene	5 / 28	0.00019 - 0.00021	0.000051 - 0.00047	OU3-SW-10-111604	0.00012	0.000049	0.00010	0.000070	Yes	ASL
53-70-3	Dibenzo(a,h)anthracene	0 / 28	0.00019 - 0.00021			0.00010		0.00010		No	ND
206-44-0	Fluoranthene	14 / 28	0.0002 - 0.0002	0.000029 - 0.0014	OU3-SW-10-111604	0.00021	0.00049	0.00020	0.0008	Yes	ASL
86-73-7	Fluorene	9 / 28	0.0002 - 0.0002	0.000058 - 0.00011	OU3-SW34-0000	0.000093		0.00010	0.019	No	BSL
193-39-5	Indeno(1,2,3-cd)pyrene	0 / 28	0.00019 - 0.00021			0.00010		0.00010		No	ND
91-20-3	Naphthalene	2 / 28	0.00019 - 0.00021	0.000079 - 0.001	OU3-SW38-0000	0.00013		0.00010	0.021	No	BSL
85-01-8	Phenanthrene	10 / 28	0.0002 - 0.0002	0.00022 - 0.00076	OU3-SW-10-111604	0.00019		0.00010	0.0023	No	BSL
129-00-0	Pyrene	12 / 28	0.0002 - 0.00021	0.000035 - 0.001	OU3-SW-10-111604	0.00014	0.000053	0.000082	0.0046	No	BSL
TotalPhenol	Total Phenols	5 / 28	0.04 - 0.04	0.012 - 0.044	OU3-SW36-0000	0.020		0.020	0.16	No	BSL
	Metals, Total (mg/L)										
7440-38-2	Arsenic	9 / 28	0.005 - 0.01	0.00059 - 0.0023	OU3-SW27-0000	0.0033	0.0031	0.0041	0.15	No	BSL
	Metals, Dissolved (mg/L)										
7440-38-2	Arsenic	7 / 28	0.005 - 0.01	0.0005 - 0.00061	OU3-SW28-0000	0.0033	0.0049	0.0040	0.15	No	BSL
	Inorganics (mg/L)										
FREE-CN	Cyanide (Free)	0 / 15	0.01 - 0.01			0.0050	0.0058	0.0051		No	ND
EIM-187	Cyanide Amenable to Chlorination	0 / 12	0.01 - 0.01			0.0050		0.0050		No	ND
57-12-5	Cyanide, Total	0 / 27	0.01 - 0.01			0.0050	0.0033	0.0048		No	ND
NO3N	Nitrate as N	13 / 13		0.66 - 0.72	OU3-SW27-0000	0.68	0.77	0.71		No	NA
NH3N	Nitrogen, as Ammonia	1 / 28	0.2 - 2	4.5 - 4.5	OU3-SW-08-111604	0.71		0.64	1	No	FOD

(1) Samples and data used in this summary are provided in Appendix F.
(2) Arithmetic mean concentration is the arithmetic mean calculated using 1/2 the detection limit for non-detects.
(3) The average and maximum background values are provided in Table 8.5.
(4) Surface water screening values are provided in Table 8.15.
(5) Parameter is selected as a Chemical of Potential Concern (COPC) if the maximum detected concentration is greater than the selected benchmark (or if a screening level is not available) unless the frequency of detection for that parameter is less than 5 %.

ASL - Maximum detected concentration is above screening level.
BSL - Maximum detected concentration is below screening level
FOD - Frequency of detection less than 5%.
ND - Not detected.
NSL - No screening level available.
NA - Not applicable

mg/L- milligrams per liter

TABLE 18
SELECTION OF CHEMICALS OF CONCERN - SURFACE WATER
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Sample ID of Maximum Concentration	Arithmetic Mean (2)	Surface Water Background (3)		Selected Benchmark (4)	Selected as COPC? (5)	Rationale
							Maximum	Average			

TABLE 19
SELECTION OF CHEMICALS OF CONCERN - SEDIMENT
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Sample ID of Maximum Concentration	Arithmetic Mean (2)	Sediment Background (3) Maximum	Sediment Background (3) Average	Selected Benchmark (4)	Selected as COPC? (5)	Rationale
	Volatile Organics (mg/kg)										
71-55-6	1,1,1-Trichloroethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
79-34-5	1,1,2,2-Tetrachloroethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
79-00-5	1,1,2-Trichloroethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
75-34-3	1,1-Dichloroethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
75-35-4	1,1-Dichloroethene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
120-82-1	1,2,4-Trichlorobenzene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
96-12-8	1,2-Dibromo-3-chloropropane (DBCP)	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
106-93-4	1,2-Dibromoethane (EDB)	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
95-50-1	1,2-Dichlorobenzene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
107-06-2	1,2-Dichloroethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
78-87-5	1,2-Dichloropropane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
541-73-1	1,3-Dichlorobenzene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
106-46-7	1,4-Dichlorobenzene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
78-93-3	2-Butanone (MEK)	6 / 8	0.008 - 0.009	0.002 - 0.018	OU3-SD-14-111604	0.0058	0.012	0.0062	0.042	No	BSL
591-78-6	2-Hexanone	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
108-10-1	4-Methyl-2-pentanone	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
67-64-1	Acetone	7 / 8	0.008 - 0.008	0.018 - 0.23	OU3-SD-14-111604	0.064	0.13	0.072	0.0099	Yes	ASL
71-43-2	Benzene	5 / 19	0.0046 - 0.019	0.0008 - 0.17	OU3-SD33-0000	0.013		0.0063	0.14	Yes	ASL
75-27-4	Bromodichloromethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
75-25-2	Bromoform	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
74-83-9	Bromomethane (Methyl bromide)	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
75-15-0	Carbon disulfide	5 / 8	0.011 - 0.018	0.001 - 0.023	OU3-SD-04-111504	0.0076	0.004	0.0041	0.024	No	BSL
56-23-5	Carbon Tetrachloride	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
108-90-7	Chlorobenzene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
75-00-3	Chloroethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
67-66-3	Chloroform	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
74-87-3	Chloromethane (Methyl chloride)	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
156-59-2	cis-1,2-Dichloroethene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
10061-01-5	cis-1,3-Dichloropropene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
110-82-7	Cyclohexane	7 / 8	0.009 - 0.009	0.001 - 0.021	OU3-SD-14-111604	0.0064	0.004	0.0049		Yes	NSL
124-48-1	Dibromochloromethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
75-71-8	Dichlorodifluoromethane	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
100-41-4	Ethylbenzene	2 / 19	0.0045 - 0.019	0.002 - 0.058	OU3-SD33-0000	0.0071		0.0063	0.18	No	BSL
98-82-8	Isopropylbenzene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
79-20-9	Methyl Acetate	6 / 8	0.008 - 0.009	0.003 - 0.13	OU3-SD-14-111604	0.023	0.042	0.022		Yes	NSL
1634-04-4	Methyl tertiary butyl ether (MTBE)	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
108-87-2	Methylcyclohexane	1 / 8	0.008 - 0.018	0.002 - 0.002	OU3-SD-14-111604	0.0049	0.002	0.0062		Yes	NSL
75-09-2	Methylene Chloride	2 / 8	0.008 - 0.019	0.001 - 0.002	OU3-SD-05-111604	0.0044		0.0080	0.16	No	BSL
100-42-5	Styrene	1 / 19	0.0045 - 0.019	0.0045 - 0.0045	OU3-SD33-0000	0.0043		0.0063	0.25	No	BSL
127-18-4	Tetrachloroethene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
108-88-3	Toluene	5 / 19	0.0045 - 0.018	0.0008 - 0.046	OU3-SD33-0000	0.0060	0.001	0.0050	1.2	No	BSL
156-60-5	trans-1,2-Dichloroethene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
10061-02-6	trans-1,3-Dichloropropene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND

Prepared by BJR 1/12/07
Checked by ALF 1/12/07

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TABLE 19
SELECTION OF CHEMICALS OF CONCERN - SEDIMENT
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Sample ID of Maximum Concentration	Arithmetic Mean (2)	Sediment Background (3)		Selected Benchmark (4)	Selected as COPC? (5)	Rationale
							Maximum	Average			
79-01-6	Trichloroethene	0 / 8	0.008 - 0.019			0.0059		0.0080		No	ND
75-69-4	Trichlorofluoromethane	0 / 8	0.008 - 0.019			0.0059		0 0080		No	ND
75-01-4	Vinyl Chloride	0 / 8	0.008 - 0.019			0.0059		0 0080		No	ND
1330-20-7	Xylenes (total)	3 / 19	0.008 - 0.019	0.001 - 0.11	OU3-SD33-0000	0.011		0.0069	0.43	No	BSL
	Semivolatile Organics (mg/kg)										
90-12-0	1-Methylnaphthalene	4 / 8	0.0089 - 0.16	0.011 - 0.051	OU3-SD-01-111504	0.041	0.046	0.020	0.02	Yes	ASL
91-57-6	2-Methylnaphthalene	15 / 19	0.0089 - 0.16	0.023 - 52	OU3-SD33-0000	2.9	0.12	0.057	0.02	Yes	ASL
83-32-9	Acenaphthene	15 / 19	0.0078 - 0.013	0.056 - 53	OU3-SD33-0000	3.7	0.11	0.027	0.0067	Yes	ASL
208-96-8	Acenaphthylene	15 / 19	0.0078 - 0.11	0.021 - 12	OU3-SD33-0000	0.77	0.057	0.023	0.0059	Yes	ASL
120-12-7	Anthracene	18 / 19	0.0000089 - 0.0000089	0.044 - 120	OU3-SD33-0000	7.2	0.16	0.052	0.057	Yes	ASL
56-55-3	Benzo(a)anthracene	19 / 19		0.044 - 48	OU3-SD33-0000	5.4	0.57	0.21	0.11	Yes	ASL
50-32-8	Benzo(a)pyrene	19 / 19		0.047 - 28	OU3-SD33-0000	4.3	0.65	0.22	0.15	Yes	ASL
205-99-2	Benzo(b)fluoranthene	19 / 19		0.057 - 23	OU3-SD33-0000	3.9	0.52	0.22	11	Yes	ASL
191-24-2	Benzo(ghi)perylene	18 / 19	0.0091 - 0.0091	0.034 - 20	OU3-SD33-0000	3.4	0.64	0.19	0.17	Yes	ASL
207-08-9	Benzo(k)fluoranthene	19 / 19		0.022 - 18	OU3-SD33-0000	2.7	0.42	0.12	0.24	Yes	ASL
218-01-9	Chrysene	19 / 19		0.052 - 51	OU3-SD33-0000	5.8	0.67	0.24	0.17	Yes	ASL
53-70-3	Dibenzo(a,h)anthracene	17 / 19	0.0089 - 0.0091	0.02 - 7.1	OU3-SD33-0000	1.1	0.22	0.058	0.033	Yes	ASL
206-44-0	Fluoranthene	19 / 19		0.092 - 170	OU3-SD33-0000	15	0.99	0.38	0.42	Yes	ASL
86-73-7	Fluorene	16 / 19	0.0078 - 0.013	0.019 - 53	OU3-SD33-0000	3.1	0.062	0.021	0.077	Yes	ASL
193-39-5	Indeno(1,2,3-cd)pyrene	18 / 19	0.0091 - 0.0091	0.028 - 19	OU3-SD33-0000	3.1	0.56	0.17	0.20	Yes	ASL
91-20-3	Naphthalene	17 / 19	0.0089 - 0.16	0.028 - 140	OU3-SD33-0000	7.6	0.096	0.035	0.18	Yes	ASL
85-01-8	Phenanthrene	19 / 19		0.044 - 160	OU3-SD33-0000	11	0.52	0.19	0.20	Yes	ASL
129-00-0	Pyrene	19 / 19		0.072 - 79	OU3-SD33-0000	7.8	0.59	0.24	0.20	Yes	ASL
TotalPhenol	Total Phenols	15 / 19	1.2 - 2.8	0.28 - 1.7	OU3-SD36-0000	0.83	12	3.4	0.049	Yes	ASL
	PCBs (mg/kg)										
12674-11-2	Aroclor 1016	0 / 11	0.047 - 0.075			0.031		0.026		No	ND
11104-28-2	Aroclor 1221	0 / 11	0.047 - 0.075			0.031		0.026		No	ND
11141-16-5	Aroclor 1232	0 / 11	0.047 - 0.075			0.031		0.026		No	ND
53469-21-9	Aroclor 1242	0 / 11	0.047 - 0.075			0.031		0.026		No	ND
12672-29-6	Aroclor 1248	2 / 11	0 057 - 0.075	0.038 - 0.14	OU3-SD33-0000	0.042		0.026	0.060	Yes	ASL
11097-69-1	Aroclor 1254	0 / 11	0.047 - 0.075			0.031		0 026		No	ND
11096-82-5	Aroclor 1260	1 / 11	0.057 - 0.075	0.019 - 0.019	OU3-SD34-0000	0.031		0.026	0 060	No	BSL
	Inorganics (mg/kg)										
7440-38-2	Arsenic	19 / 19		3 - 11.7	OU3-SD-10-111604	6.3	12.3	7.5	9.8	Yes	ASL
FREE-CN	Cyanide (Free)	0 / 8	0.58 - 1.4			0.40		0.53		No	ND
57-12-5	Cyanide, Total	0 / 11	0.72 - 1.1			0.47		0.39		No	ND
NH3N	Nitrogen, as Ammonia	7 / 19	0.2 - 3.8	0.07 - 63	OU3-SD30-0000	7.5	2.1	0.81	100	No	BSL
SOLID	Percent Solids	29 / 29		35.1 - 85.9	OU3-SD-04-111504	57	73.1	58		NA	NA
DRY	Solids, Percent	8 / 8		39.3 - 86.5	OU3-SD-04-111504	67	71.5	54		NA	NA
TOC	Total Organic Carbon	11 / 11		6400 - 19000	OU3-SD33-0000	16036	9500	8900		NA	NA

TABLE 19
SELECTION OF CHEMICALS OF CONCERN - SEDIMENT
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	Chemical (1)	Frequency of Detection	Range of Non Detects	Range of Detected Concentrations	Sample ID of Maximum Concentration	Arithmetic Mean (2)	Sediment Background (3)		Selected Benchmark (4)	Selected as COPC? (5)	Rationale
							Maximum	Average			

(1) Samples and data used in this summary are provided in Appendix F.
(2) Arithmetic mean concentration is the arithmetic mean calculated using 1/2 the detection limit for non-detects.
(3) The average and maximum background values are provided in Table 8.8.
(4) Sediment screening values are provided in Table 8.16.
(5) Parameter is selected as a Chemical of Potential Concern (COPC) if the maximum detected concentration is greater than the selected benchmark (or if a screening level is not available) unless the frequency of detection for that parameter is less than 5 %.
ASL - Maximum detected concentration is above screening level.
BSL - Maximum detected concentration is below screening level
FOD - Frequency of detection less than 5%.
ND - Not detected.
NSL - No screening level available.
NA - Not applicable
mg/kg- milligrams per kilograms

TABLE 20
SUMMARY OF POTENTIAL EXPOSURE PATHWAYS
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Receptor	Exposure Pathways					
	Surface Water	Surface Sediment (0-1 ft.)	Subsurface Sediment (>1 ft.)	Surface Soil (0-3 ft)	Subsurface Soil (>3 ft)	Biota
Aquatic Receptors (Fish, Amphibians, Invertebrates, and Plants)	√	√	Top 0.5 to 1 ft. is the most biologically active zone of sediments. No exposure to subsurface sediment	No exposure of fish to surface soil; expsoure of amphibians is limited and not likely to be significant	No exposure to subsurface soil	√ (If bioaccumulative COPCs present)
Herbivorous Waterfowl (e.g., Mallard)	√ Drinking water ingestion	√ Limited, incidental while foraging at river edge	No exposure to subsurface sediment	Assume only limited exposure to surface soil; exposures likely to be less than for terrestrial wildlife	No exposure to subsurface soil	√ (If bioaccumulative COPCs present)
Piscivorous Birds (e.g., Belted Kingfisher)	√ Drinking water ingestion	√ Limited, incidental while foraging at river edge	No exposure to subsurface sediment	Assume only limited exposure to surface soil; exposures likely to be less than for terrestrial wildlife	No exposure to subsurface soil	√ (If bioaccumulative COPCs present)
Herbivorous Semi-Aquatic mammals (e.g., Muskrat)	√ Drinking water ingestion	√ Limited, incidental while foraging at river edge	No exposure to subsurface sediment	Assume only limited exposure to surface soil; exposures likely to be less than for terrestrial wildlife	No exposure to subsurface soil	√ (If bioaccumulative COPCs present)
Omnivorous Semiaquatic Mammals (e.g., raccoon)	√ Drinking water ingestion	√ Limited, incidental while foraging at river edge	No exposure to subsurface sediment	Assume only limited exposure to surface soil; exposures likely to be less than for terrestrial wildlife	No exposure to subsurface soil	√ (If bioaccumulative COPCs present)

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Prepared by: BJR 1/12/07
Checked by:ALF 1/12/07

TABLE 20
SUMMARY OF POTENTIAL EXPOSURE PATHWAYS
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

	Exposure Pathways					
Receptor	**Surface Water**	**Surface Sediment (0-1 ft.)**	**Subsurface Sediment (>1 ft.)**	**Surface Soil (0-3 ft)**	**Subsurface Soil (>3 ft)**	**Biota**
Terrestrial Plants & Invertebrates	No exposure to surface water	No exposure to sediment	No exposure to subsurface sediment	√	No exposure to subsurface soil	Assumed to be insignificant
Vermivorous Small Birds (e.g., American Robin)	√ Drinking water ingestion	Assume only limited exposure to sediment; exposures likely to be less than for semi-aquatic wildlife	No exposure to subsurface sediment	√	No exposure to subsurface soil	√ (If bioaccumulative COPCs present)
Predatory Birds (e.g., American Kestrel)	√ Drinking water ingestion	Assume only limited exposure to sediment; exposures likely to be less than for semi-aquatic wildlife	No exposure to subsurface sediment	√	No exposure to subsurface soil	√ (If bioaccumulative COPCs present)
Herbivorous Small Mammals (e.g., Meadow Vole)	√ Drinking water ingestion	Assume only limited exposure to sediment; exposures likely to be less than for semi-aquatic wildlife	No exposure to subsurface sediment	√	No exposure to subsurface soil	√ (If bioaccumulative COPCs present)
Omnivorous Mammals (e.g., Red Fox)	√ Drinking water ingestion	Assume only limited exposure to sediment; exposures likely to be less than for semi-aquatic wildlife	No exposure to subsurface sediment	√	No exposure to subsurface soil	√ (If bioaccumulative COPCs present)

ft - feet
in. - inches

TABLE 21
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - SURFACE SOIL
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern (1)	Units	Arithmetic Mean	95% UCL (2) (calculation)		Maximum Detected Concentration (qualifier)	Exposure Point Concentration (EPC)			
						Reasonable Maximum (3)		Central Tendency (4)	
						Value	Statistic	Value	Statistic
Volatile Organics (mg/kg)									
Benzene	mg/kg	0.24	0.85	NP [a]	7.6	0.85	UCL	0.24	Mean
Ethylbenzene	mg/kg	0.53	2.7	NP [a]	29	2.7	UCL	0.53	Mean
Styrene	mg/kg	0.60	2.8	NP [a]	26	2.8	UCL	0.60	Mean
Toluene	mg/kg	0.54	2.5	NP [a]	25	2.5	UCL	0.54	Mean
Xylenes (total)	mg/kg	2.2	18	NP [b]	130	18	UCL	2.2	Mean
Semivolatile Organics (mg/kg)									
1-Methylnaphthalene	mg/kg	21	226	NP [b]	370	226	UCL	21	Mean
2-Methylnaphthalene	mg/kg	52	534	LN [d]	820	534	UCL	52	Mean
Acenaphthene	mg/kg	82	2561	LN [d]	1100	1100	Maximum	82	Mean
Anthracene	mg/kg	130	520	LN [e]	4300	520	UCL	130	Mean
Benzo(a)anthracene	mg/kg	116	460	NP [b]	2000	460	UCL	116	Mean
Benzo(a)pyrene	mg/kg	134	552	NP [b]	2400	552	UCL	134	Mean
Benzo(b)fluoranthene	mg/kg	131	515	NP [b]	2100	515	UCL	131	Mean
Benzo(ghi)perylene	mg/kg	106	438	NP [b]	2100	438	UCL	106	Mean
Benzo(k)fluoranthene	mg/kg	76	328	NP [b]	1700	328	UCL	76	Mean
Chrysene	mg/kg	122	474	NP [b]	2100	474	UCL	122	Mean
Dibenzo(a,h)anthracene	mg/kg	28	123	NP [b]	630	123	UCL	28	Mean
Fluoranthene	mg/kg	277	1029	NP [b]	3900	1029	UCL	277	Mean
Fluorene	mg/kg	66	2063	LN [d]	920	920	Maximum	66	Mean
Indeno(1,2,3-cd)pyrene	mg/kg	92	385	NP [b]	1900	385	UCL	92	Mean
Naphthalene	mg/kg	278	1999	LN [d]	11000	1999	UCL	278	Mean
Phenanthrene	mg/kg	236	899	NP [b]	3800	899	UCL	236	Mean
Pyrene	mg/kg	186	701	NP [b]	2900	701	UCL	186	Mean
Total Phenols	mg/kg	5.5	21	NP [a]	170 J	21	UCL	5.5	Mean
PCBs (mg/kg)									
Aroclor 1248	mg/kg	0.41	3.0	NP [b]	4.8 J	3.0	UCL	0.41	Mean
Aroclor 1260	mg/kg	0.96	2.2	G [f]	6.5	2.2	UCL	0.96	Mean
Inorganics (mg/kg)									
Arsenic	mg/kg	6.8	8.8	NP [c]	18.7 J	8.8	UCL	6.8	Mean
Cyanide, Total	mg/kg	0.82	2.0	NP [c]	14	2.0	UCL	0.82	Mean

(1) Chemicals of potential concern are identified in the COPC selection tables.
(2) 95 % UCL is calculated using ProUCL software (V. 3.02); calculations presented in Appendix F.
(3) Reasonable Maximum Exposure EPC is the lesser of the maximum or 95% UCL.
(4) Central Tendency Exposure EPC is the lesser of the arithmetic mean or maximum.

NP - Nonparametrically distributed data
- [a] - 97.5% Chebyshev (Mean, Sd) UCL
- [b] - 99% Chebyshev (Mean, Sd) UCL
- [c] - 95% Chebyshev (Mean, Sd) UCL

LN - Log-normally distributed data
- [d] - 97.5% Chebyshev (MVUE) UCL
- [e] - Hall's Bootstrap UCL

G - Gamma distributed Data
- [f] - Adjusted Gamma UCL

UCL = Upper Confidence Limit on the arithmetic mean
J - Value is estimated.
mg/kg - milligrams per kilogram

TABLE 22
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - SURFACE WATER
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern (1)	Units	Arithmetic Mean	95% UCL (2) (calculation)		Maximum Detected Concentration (qualifier)	Exposure Point Concentration (EPC)			
						Reasonable Maximum (3)		Central Tendency (4)	
						Value	Statistic	Value	Statistic
Volatile Organics									
1,1,2-Trichloro-1,2,2-Trifluoroethane	mg/L	0.00024	0.00026	NP [a]	0.00012 J	0.00012	Maximum	0.00012	Maximum
Cyclohexane	mg/L	0.00024	0.00026	NP [a]	0.00012 J	0.00012	Maximum	0.00012	Maximum
Semivolatile Organics									
Benzo(a)anthracene	mg/L	0.00012	0.00021	NP [b]	0.00066	0.00021	UCL	0.00012	Mean
Benzo(a)pyrene	mg/L	0.00011	0.00014	NP [a]	0.00044	0.00014	UCL	0.00011	Mean
Benzo(b)fluoranthene	mg/L	0.00011	0.00013	NP [a]	0.00043	0.00013	UCL	0.00011	Mean
Benzo(k)fluoranthene	mg/L	0.00011	0.00013	NP [a]	0.00043	0.00013	UCL	0.00011	Mean
Chrysene	mg/L	0.00012	0.00015	NP [a]	0.00047	0.00015	UCL	0.00012	Mean
Fluoranthene	mg/L	0.00021	0.00047	NP [b]	0.0014	0.00047	UCL	0.00021	Mean

(1) Chemicals of potential concern are identified in the COPC selection tables.
(2) 95 % UCL is calculated using ProUCL software (V. 3.02); calculations presented in Appendix F.
(3) Reasonable Maximum Exposure EPC is the lesser of the maximum or 95% UCL.
(4) Central Tendency Exposure EPC is the lesser of the arithmetic mean or maximum.
NP - Non-Parametric distribution
[a] Mod-t UCL (Adjusted for skewness)
[b] 95% Chebyshev (Mean, Sd) UCL

UCL - Upper Confidence Limit on the arithmetic mean
J - Value is estimated.
mg/L - milligrams per liter

TABLE 23
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - SEDIMENT
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern (1)	Units	Arithmetic Mean	95% UCL (2) (calculation)		Maximum Detected Concentration (qualifier)	Exposure Point Concentration (EPC)			
						Reasonable Maximum (3)		Central Tendency (4)	
						Value	Statistic	Value	Statistic
Volatile Organics									
Acetone	mg/kg	0.064	0.15	G [a]	0.23 J	0.15	UCL	0.064	Mean
Benzene	mg/kg	0.013	0.10	NP [c]	0.17	0.10	UCL	0.013	Mean
Cyclohexane	mg/kg	0.0064	0.016	G [a]	0.021 J	0.016	UCL	0.0064	Mean
Methyl Acetate	mg/kg	0.023	0.12	NP [d]	0.13 J	0.12	UCL	0.023	Mean
Methylcyclohexane	mg/kg	0.0049	0.0063	N [h]	0.002 J	0.0020	Maximum	0.0020	Maximum
Semivolatile Organics									
1-Methylnaphthalene	mg/kg	0.041	0.058	N [h]	0.051	0.051	Maximum	0.041	Mean
2-Methylnaphthalene	mg/kg	2.9	30	NP [c]	52	30	UCL	2.9	Mean
Acenaphthene	mg/kg	3.7	31	NP [c]	53	31	UCL	3.7	Mean
Acenaphthylene	mg/kg	0.77	2.6	LN [i]	12	2.6	UCL	0.77	Mean
Anthracene	mg/kg	7.2	111	NP [f]	120	111	UCL	7.2	Mean
Benzo(a)anthracene	mg/kg	5.4	33	LN [i]	48	33	UCL	5.4	Mean
Benzo(a)pyrene	mg/kg	4.3	29	LN [i]	28	28	Maximum	4.3	Mean
Benzo(b)fluoranthene	mg/kg	3.9	24	LN [i]	23 J	23	Maximum	3.9	Mean
Benzo(ghi)perylene	mg/kg	3.4	7.5	G [b]	20	7.5	UCL	3.4	Mean
Benzo(k)fluoranthene	mg/kg	2.7	18	LN [i]	18	18	Maximum	2.7	Mean
Chrysene	mg/kg	5.8	35	LN [i]	51	35	UCL	5.8	Mean
Dibenzo(a,h)anthracene	mg/kg	1.1	2.5	G [b]	7.1	2.5	UCL	1.1	Mean
Fluoranthene	mg/kg	15	85	LN [i]	170	85	UCL	15	Mean
Fluorene	mg/kg	3.1	11	LN [i]	53	11	UCL	3.1	Mean
Indeno(1,2,3-cd)pyrene	mg/kg	3.1	6.9	G [b]	19	6.9	UCL	3.1	Mean
Naphthalene	mg/kg	7.6	81	NP [c]	140	81	UCL	7.6	Mean
Phenanthrene	mg/kg	11	43	LN [i]	160	43	UCL	11	Mean
Pyrene	mg/kg	7.8	43	LN [i]	79	43	UCL	7.8	Mean
Total Phenols	mg/kg	0.83	1.0	N [h]	1.7 J	1.0	UCL	0.83	Mean
PCBs									
Aroclor 1248	mg/kg	0.042	0.061	NP [g]	0.14 J	0.061	UCL	0.042	Mean
Inorganics									
Arsenic	mg/kg	6.3	8	G [a]	11.7	8	UCL	6.3	Mean

TABLE 23
SUMMARY OF EXPOSURE POINT CONCENTRATIONS - SEDIMENT
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

Chemical of Potential Concern (1)	Units	Arithmetic Mean	95% UCL (2) (calculation)	Maximum Detected Concentration (qualifier)	Exposure Point Concentration (EPC)			
					Reasonable Maximum (3)		Central Tendency (4)	
					Value	Statistic	Value	Statistic

(1) Chemicals of potential concern are identified in the COPC selection tables.
(2) 95 % UCL is calculated using ProUCL software (V. 3.02); calculations presented in Appendix F.
(3) Reasonable Maximum Exposure EPC is the lesser of the maximum or 95% UCL.
(4) Central Tendency Exposure EPC is the lesser of the arithmetic mean or maximum.

G - Gamma distributed Data
- [a] - Approximate Gamma UCL
- [b] - Adjusted Gamma UCL

NP - Nonparametrically distributed data
- [c] - 99% Chebyshev (Mean, Sd) UCL
- [d] - 95% Chebyshev (Mean, Sd) UCL
- [e] - 95% Chebyshev (Mean, Sd) UCL
- [f] - Hall's Bootstrap UCL
- [g] - Mod-t UCL (Adjusted for skewness)

N- Normally distributed data
- [h] - Student's-t UCL

LN - Log-normally distributed data
- [i] - 99% Chebyshev (MVUE) UCL

UCL - Upper Confidence Limit on the arithmetic mean
J - Value is estimated.
ND - Not Detected
mg/kg - milligrams per kilogram

TABLE 24
COMPARISON OF SURFACE SOIL EXPOSURE POINT CONCENTRATIONS TO LITERATURE BENCHMARK VALUES
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	COPC (1)	Frequency of Detection	EPCs (2)		Soil Background (3)		Selected Benchmark (4)	Hazard Quotients (5)				Incremental Risks (6)	
			RME	CTE	RME	CTE		Site RME	Site CTE	Background RME	Background CTE	RME	CTE
	Volatile Organics (mg/kg)												
71-43-2	Benzene	35 / 84	0.85	0.24			0.26	**3.3E+00**	9.4E-01	--	--	--	--
100-41-4	Ethylbenzene	40 / 84	2.7	0.53			5.2	5.2E-01	1.0E-01	--	--	--	--
100-42-5	Styrene	9 / 84	2.8	0.60			4.7	5.9E-01	1.3E-01	--	--	--	--
108-88-3	Toluene	30 / 84	2.5	0.54			5.5	4.5E-01	9.9E-02	--	--	--	--
1330-20-7	Xylenes (total)	52 / 84	18	2.2			10	**1.8E+00**	2.2E-01	--	--	--	--
	Semivolatile Organics (mg/kg)												
90-12-0	1-Methylnaphthalene	8 / 18	226	21			3.2	**7.0E+01**	**6.6E+00**	--	--	--	--
91-57-6	2-Methylnaphthalene	70 / 84	534	52			3.2	**1.6E+02**	**1.6E+01**	--	--	--	--
83-32-9	Acenaphthene	80 / 84	1100	82			682	**1.6E+00**	1.2E-01	--	--	--	--
120-12-7	Anthracene	80 / 84	520	130			1480	3.5E-01	8.8E-02	--	--	--	--
56-55-3	Benzo(a)anthracene	81 / 84	460	116			5.2	**8.8E+01**	**2.2E+01**	--	--	--	--
50-32-8	Benzo(a)pyrene	81 / 84	552	134			1.5	**3.6E+02**	**8.8E+01**	--	--	--	--
205-99-2	Benzo(b)fluoranthene	81 / 84	515	131			60	**8.6E+00**	**2.2E+00**	--	--	--	--
191-24-2	Benzo(ghi)perylene	77 / 84	438	106			119	**3.7E+00**	8.9E-01	--	--	--	--
207-08-9	Benzo(k)fluoranthene	79 / 84	328	76			148	**2.2E+00**	5.1E-01	--	--	--	--
218-01-9	Chrysene	81 / 84	474	122			4.7	**1.0E+02**	**2.6E+01**	--	--	--	--
53-70-3	Dibenzo(a,h)anthracene	76 / 84	123	28			18	**6.7E+00**	**1.5E+00**	--	--	--	--
206-44-0	Fluoranthene	82 / 84	1029	277			122	**8.4E+00**	**2.3E+00**	--	--	--	--
86-73-7	Fluorene	78 / 84	920	66			122	**7.5E+00**	5.4E-01	--	--	--	--
193-39-5	Indeno(1,2,3-cd)pyrene	77 / 84	385	92			109	**3.5E+00**	8.4E-01	--	--	--	--
91-20-3	Naphthalene	81 / 84	1999	278			0.099	**2.0E+04**	**2.8E+03**	--	--	--	--
85-01-8	Phenanthrene	82 / 84	899	236			46	**2.0E+01**	**5.1E+00**	--	--	--	--
129-00-0	Pyrene	82 / 84	701	186			79	**8.9E+00**	**2.4E+00**	--	--	--	--
TotalPhenol	Total Phenols	38 / 74	21	5.5			122	1.7E-01	4.5E-02	--	--	--	--
	PCBs (mg/kg)												
12672-29-6	Aroclor 1248	8 / 18	3.0	0.41			0.00033	**9.2E+03**	**1.3E+03**	--	--	--	--
11096-82-5	Aroclor 1260	17 / 18	2.2	0.96			0.00033	**6.7E+03**	**2.9E+03**	--	--	--	--
	Inorganics (mg/kg)												
7440-38-2	Arsenic	73 / 73	8.8	6.8			18	4.9E-01	3.8E-01	--	--	--	--
57-12-5	Cyanide, Total	10 / 59	2.0	0.82			1.3	**1.5E+00**	6.3E-01	--	--	--	--

(1) COPCs are identified in Table 8.2.
(2) Exposure point concentrations are derived in Table 8.10; RME EPC = lesser of maximum or 95% UCL; CTE EPC = lesser of arithmetic mean or maximum.
(3) Background data not available.
(4) Surface soil screening values are provided in Table 8.14.
(5) Calculated by dividing EPC by Selected Benchmark.
(6) The incremental risk is the hazard quotient calculated for the Site minus the hazard quotient calculated for background.

EPC - Exposure Point Concentration
RME - Reasonable Maximum Exposure
CTE - Central Tendency Exposure
mg/kg - milligrams per kilogram
-- - Not available. Not analyzed for in background samples, and/or no benchmark available.
NC - Not calculated; no benchmark available

TABLE 24
COMPARISON OF SURFACE SOIL EXPOSURE POINT CONCENTRATIONS TO LITERATURE BENCHMARK VALUES
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	COPC (1)	Frequency of Detection	EPCs (2)		Soil Background (3)		Selected Benchmark (4)	Hazard Quotients (5)				Incremental Risks (6)	
			RME	CTE	RME	CTE		Site RME	Site CTE	Background RME	Background CTE	RME	CTE

Bold = Hazard Quotient or Incremental Risk > 1

TABLE 25
COMPARISON OF SURFACE WATER EXPOSURE POINT CONCENTRATIONS TO LITERATURE BENCHMARK VALUES
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

CAS Number	COPC (1)	Frequency of Detection	EPCs (2)		Surface Water Background (3)		Selected Benchmark (4)	Hazard Quotients (5)				Incremental Risks (6)	
			RME	CTE	RME	CTE		Site RME	Site CTE	Background RME	Background CTE	RME	CTE
	Volatile Organics (mg/L)												
76-13-1	1,1,2-Trichloro-1,2,2-Trifluoroethane	1 / 15	0.00012	0.00012		0.00025	--	NC	NC	--	NC	NC	NC
110-82-7	Cyclohexane	1 / 15	0.00012	0.00012		0.00025	--	NC	NC	--	NC	NC	NC
	Semivolatile Organics (mg/L)												
56-55-3	Benzo(a)anthracene	7 / 28	0.00021	0.00012	0.000046	0.0000811	0.000027	**7.8E+00**	**4.3E+00**	**1.7E+00**	**3.0E+00**	**6.0E+00**	**1.3E+00**
50-32-8	Benzo(a)pyrene	2 / 28	0.00014	0.00011		0.0001005	0.000014	**9.7E+00**	**8.0E+00**	--	**7.2E+00**	**9.7E+00**	8.7E-01
205-99-2	Benzo(b)fluoranthene	5 / 28	0.00013	0.00011	0.000088	0.0000993	0.00042	3.2E-01	2.6E-01	2.1E-01	2.4E-01	1.1E-01	2.8E-02
207-08-9	Benzo(k)fluoranthene	2 / 28	0.00013	0.00011		0.0001005	0.00014	9.6E-01	8.0E-01	--	7.2E-01	9.6E-01	8.4E-02
218-01-9	Chrysene	5 / 28	0.00015	0.00012	0.000049	0.0000954	0.00007	**2.1E+00**	**1.7E+00**	7.0E-01	**1.4E+00**	**1.4E+00**	3.4E-01
206-44-0	Fluoranthene	14 / 28	0.00047	0.00021	0.00049	0.0002005	0.0008	5.9E-01	2.6E-01	6.1E-01	2.5E-01	-2.1E-02	8.0E-03

(1) COPCs are identified in Table 8.4.
(2) Exposure point concentrations are derived in Table 8.11; RME EPC = lesser of maximum or 95% UCL; CTE EPC = lesser of arithmetic mean or maximum.
(3) The CTE and RME background values are provided in Table 8.5.
(4) Surface water screening values are provided in Table 8.15.
(5) Calculated by dividing EPC by Selected Benchmark.
(6) The incremental risk is the hazard quotient calculated for the Site minus the hazard quotient calculated for background.

EPC - Exposure Point Concentration
RME - Reasonable Maximum Exposure
CTE - Central Tendency Exposure
mg/L- milligrams per liter
-- - Not available. Not analyzed for in background samples, and/or no benchmark available.
NC - Not calculated; no benchmark available
Bold = Hazard Quotient or Incremental Risk > 1

TABLE 26
COMPARISON OF SEDIMENT EXPOSURE POINT CONCENTRATIONS TO LITERATURE BENCHMARK VALUES
PHASE IA REMEDIAL INVESTIGATION REPORT
OPERABLE UNIT 3 - IRONTON TAR PLANT
IRONTON, OHIO

			EPCs (2)		Sediment Background (3)			Hazard Quotients (5)				Incremental Risks (6)	
CAS Number	COPC (1)	Frequency of Detection	RME	CTE	RME	CTE	Selected Benchmark (4)	Site RME	Site CTE	Background RME	Background CTE	RME	CTE
	Volatile Organics (mg/kg)												
67-64-1	Acetone	7 / 8	0.15	0.064	0.13	0.072	0.0099	**1.5E+01**	**6.5E+00**	**1.3E+01**	**7.2E+00**	**1.9E+00**	-7.7E-01
71-43-2	Benzene	5 / 19	0.10	0.013		0.0063	0.14	7.1E-01	9.2E-02	--	4.5E-02	7.1E-01	4.7E-02
110-82-7	Cyclohexane	7 / 8	0.016	0.0064	0.0040	0.0049	--	NC	NC	NC	NC	NC	NC
79-20-9	Methyl Acetate	6 / 8	0.12	0.023	0.042	0.022	--	NC	NC	NC	NC	NC	NC
108-87-2	Methylcyclohexane	1 / 8	0.0020	0.0020	0.0020	0.0062	--	NC	NC	NC	NC	NC	NC
	Semivolatile Organics (mg/kg)												
90-12-0	1-Methylnaphthalene	4 / 8	0.051	0.041	0.046	0.020	0.020	**2.6E+00**	**2.1E+00**	**2.3E+00**	9.8E-01	2.5E-01	**1.1E+00**
91-57-6	2-Methylnaphthalene	15 / 19	30	2.9	0.12	0.057	0.020	**1.5E+03**	**1.4E+02**	**6.0E+00**	**2.8E+00**	**1.5E+03**	**1.4E+02**
83-32-9	Acenaphthene	15 / 19	31	3.7	0.11	0.027	0.0067	**4.7E+03**	**5.5E+02**	**1.6E+01**	**4.0E+00**	**4.6E+03**	**5.4E+02**
208-96-8	Acenaphthylene	15 / 19	2.6	0.77	0.057	0.023	0.0059	**4.4E+02**	**1.3E+02**	**9.7E+00**	**3.9E+00**	**4.3E+02**	**1.3E+02**
120-12-7	Anthracene	18 / 19	111	7.2	0.16	0.052	0.057	**1.9E+03**	**1.3E+02**	**2.8E+00**	9.1E-01	**1.9E+03**	**1.3E+02**
56-55-3	Benzo(a)anthracene	19 / 19	33	5.4	0.57	0.21	0.11	**3.0E+02**	**5.0E+01**	**5.3E+00**	**2.0E+00**	**3.0E+02**	**4.8E+01**
50-32-8	Benzo(a)pyrene	19 / 19	28	4.3	0.65	0.22	0.15	**1.9E+02**	**2.9E+01**	**4.3E+00**	**1.5E+00**	**1.8E+02**	**2.7E+01**
205-99-2	Benzo(b)fluoranthene	19 / 19	23	3.9	0.52	0.22	11	**2.1E+00**	3.6E-01	4.7E-02	2.0E-02	**2.0E+00**	3.4E-01
191-24-2	Benzo(ghi)perylene	18 / 19	7.5	3.4	0.64	0.19	0.17	**4.4E+01**	**2.0E+01**	**3.8E+00**	**1.1E+00**	**4.0E+01**	**1.9E+01**
207-08-9	Benzo(k)fluoranthene	19 / 19	18	2.7	0.42	0.12	0.24	**7.5E+01**	**1.1E+01**	**1.8E+00**	5.0E-01	**7.3E+01**	**1.1E+01**
218-01-9	Chrysene	19 / 19	35	5.8	0.67	0.24	0.17	**2.1E+02**	**3.5E+01**	**4.0E+00**	**1.5E+00**	**2.1E+02**	**3.3E+01**
53-70-3	Dibenzo(a,h)anthracene	17 / 19	2.5	1.1	0.22	0.058	0.033	**7.7E+01**	**3.4E+01**	**6.7E+00**	**1.8E+00**	**7.0E+01**	**3.2E+01**
206-44-0	Fluoranthene	19 / 19	85	15	0.99	0.38	0.42	**2.0E+02**	**3.6E+01**	**2.3E+00**	8.9E-01	**2.0E+02**	**3.5E+01**
86-73-7	Fluorene	16 / 19	11	3.1	0.062	0.021	0.077	**1.4E+02**	**4.1E+01**	8.1E-01	2.8E-01	**1.4E+02**	**4.0E+01**
193-39-5	Indeno(1,2,3-cd)pyrene	18 / 19	6.9	3.1	0.56	0.17	0.20	**3.4E+01**	**1.5E+01**	**2.8E+00**	8.4E-01	**3.1E+01**	**1.4E+01**
91-20-3	Naphthalene	17 / 19	81	7.6	0.096	0.035	0.18	**4.5E+02**	**4.2E+01**	5.3E-01	2.0E-01	**4.5E+02**	**4.2E+01**
85-01-8	Phenanthrene	19 / 19	43	11	0.52	0.19	0.20	**2.1E+02**	**5.4E+01**	**2.5E+00**	9.3E-01	**2.1E+02**	**5.3E+01**
129-00-0	Pyrene	19 / 19	43	7.8	0.59	0.24	0.20	**2.2E+02**	**4.0E+01**	**3.0E+00**	**1.2E+00**	**2.2E+02**	**3.9E+01**
TotalPhenol	Total Phenols	15 / 19	1.0	0.83	12	3.4	0.049	**2.0E+01**	**1.7E+01**	**2.4E+02**	**6.8E+01**	-2.2E+02	-5.1E+01
	PCBs (mg/kg)												
12672-29-6	Aroclor 1248	2 / 11	0.061	0.042		0.026	0.060	**1.0E+00**	7.0E-01	--	4.3E-01	**1.0E+00**	2.6E-01
	Inorganics (mg/kg)												
7440-38-2	Arsenic	19 / 19	7.6	6.3	12	7.5	9.8	7.8E-01	6.4E-01	**1.3E+00**	7.6E-01	-4.8E-01	-1.2E-01

(1) COPCs are identified in Table 8.7.
(2) Exposure point concentrations are derived in Table 8.12; RME EPC = lesser of maximum or 95% UCL; CTE EPC = lesser of arithmetic mean or maximum
(3) The CTE and RME background values are provided in Table 8.8.
(4) Sediment screening values are provided in Table 8.16.
(5) Calculated by dividing EPC by Selected Benchmark.
(6) The incremental risk is the hazard quotient calculated for the Site minus the hazard quotient calculated for background.

EPC - Exposure Point Concentration
RME - Reasonable Maximum Exposure
CTE - Central Tendency Exposure
mg/Kg- milligrams per kilogram
-- - Not available. Not analyzed for in background samples, and/or no benchmark available.
NC - Not calculated; no benchmark available
Bold = Hazard Quotient or Incremental Risk > 1

TABLE 27
CHEMICAL-SPECIFIC ARARs FOR SOIL

REGULATORY AUTHORITY	MEDIA	REQUIREMENT	STATUS	REQUIREMENT/SYNOPSIS
State	Soil	Ohio Environmental Protection Agency Voluntary Action Program -- Generic Direct-Contact Soil Standards for Commercial/industrial property.	Relevant and Appropriate	Provides generic numerical standards and the option of developing site-specific criteria for direct contact with soil based on a single chemical exposure resulting from ingestion of soil, dermal contact with soil and inhalation of volatile and particulate emissions outdoors from soil.
Federal	Soil	USEPA Risk Reference Doses	To Be Considered	Risk reference doses are estimates of daily exposure levels that are unlikely to cause significant adverse non-carcinogenic health effects over a lifetime.
Federal	Soil	USEPA Carcinogen Assessment Group, Cancer Slope Factors	To Be Considered	Cancer Slope Factors are used to compute the incremental cancer risk from exposure to site contaminants and represent the most up-to-date information on cancer risk from USEPA's Carcinogen Assessment Group.
Federal	Soil/Air (particulate)	USEPA Region 9 Preliminary Remediation Goals	To Be Considered	USEPA Region 9 Preliminary Remediation Goals are risk-based screening tools for evaluating contaminated sites. The PRGs represent Agency guidelines and are not legally enforceable standards.

TABLE 28
LOCATION-SPECIFIC ARARS

REGULATORY AUTHORITY	NATURAL FEATURE/ SENSITIVE AREA	REQUIREMENT	STATUS	REQUIREMENT/SYNOPSIS
Federal	Floodplains	Floodplain Management Executive Order 11988 [40 CFR Part 6, Appendix A]	Applicable	Requires federal agencies to evaluate the potential adverse effects associated with direct and indirect development of a floodplain. Alternatives that involve modification/construction within a floodplain may not be selected unless a determination is made that no practicable alternative exists. If no practicable alternative exists, potential harm must be minimized and action taken to restore and preserve the natural and beneficial values of the floodplain.
State		Ohio Floodplain Regulation Criteria established under the Ohio Revised Code, Section 1521	Applicable	Provides uniformity in the engineering analysis of proposed floodplain development and to ensure that Ohio communities have access to floodplain management regulations that are consistent with local, regional, and state goals and that meet or exceed the minimum requirements of the National Flood Insurance Program.
Federal	Wetlands	Protection of Wetlands Executive Order 11990 [40 CFR Part, 6 Appendix A]	Applicable	Under this Order, federal agencies are required to minimize the destruction, loss, or degradation of wetlands, and preserve and enhance natural and beneficial values of wetlands. If remediation is required within wetland areas and no practical alternative exists, potential harm must be minimized and action taken to restore natural and beneficial values.
State		Water Quality Standards - Ohio Administrative Code 3745-1	Applicable	Maintain and protect wetland such that degradation of surface waters through direct, indirect, or cumulative impacts does not result in the net loss of wetland acreage or functions

TABLE 28
LOCATION-SPECIFIC ARARS

REGULATORY AUTHORITY	NATURAL FEATURE/ SENSITIVE AREA	REQUIREMENT	STATUS	REQUIREMENT/SYNOPSIS
State	Surface Waters, Endangered Species, Migratory Species	Fish and Wildlife Coordination Act [16 USC 661 et seq.]	Applicable	Actions that affect species/habitat require consultation with U.S. Department of Interior, U.S. Fish and Wildlife Service, and National Marine Fisheries Service, and/or state agencies, as appropriate, to ensure that proposed actions do not jeopardize the continued existence of the species or adversely modify or destroy critical habitat. The effects of water-related projects on fish and wildlife resources must be considered. Action must be taken to prevent, mitigate, or compensate for project --related damages or losses to fish and wildlife resources. Consultation with the responsible agency is also strongly recommended for on-site actions. Under 40 CFR Part 300.38, these requirements apply to all response activities under the National Contingency Plan.
		Water Quality Standards - Ohio Administrative Code 3745-1	Applicable	Establishes minimum water quality requirements for all surface waters of the state, thereby protecting public health and welfare; and to enhance, improve and maintain water quality as provided under the laws of the state of Ohio.

TABLE 29
ACTION-SPECIFIC ARARs

ACTION	REGULATORY AUTHORITY	REQUIREMENT	STATUS	DESCRIPTION
Offsite Land Disposal	Federal	Resource Conservation and Recovery Act, Subtitle C	Applicable	Soil that is excavated for offsite disposal and constitutes a hazardous waste must be managed in accordance with the requirements of RCRA (40 CFR 260-268).
		Resource Conservation and Recovery Act, Subtitle D	Applicable	40 CFR 258, Criteria for Municipal Solid Waste Landfills, establishes requirements for the operation of landfills accepting non-hazardous solid waste. These requirements would be applicable to facilities used for the disposal of non-hazardous soil and/or sediment.
		U.S. Dept. of Transportation Requirements for the Transport of Hazardous Materials	Applicable	Transportation of hazardous materials on public roadways must comply with the requirements of 49 CFR 172.
	State	Ohio Hazardous Waste Management Standards	Applicable	Soil constituting a hazardous waste must be managed in accordance with OAC Title 3745, Chapters 51-57, 65-69, 205, 256, 266, and 270, as appropriate.
		Ohio Solid Waste and Infectious Waste Regulations	Applicable	Disposal of non-hazardous solid wastes is regulated by the State of Ohio under OAC Title 3745, Ch. 27. Off-site disposal of non-hazardous soils and/or sediments must comply with these regulations.
Site Capping	Federal	Rivers and Harbors Act, Section 10 33 CFR parts 320 to 323	Applicable.	Activities that could impede navigation and commerce are prohibited. Prohibits authorized obstruction or alteration of any navigable waterway.
	State	Ohio Solid Waste Standards	Relevant and Appropriate	Installation of an engineered cap is regulated by Ohio EPA's OAC 3745-27-08

TABLE 29
ACTION-SPECIFIC ARARs

ACTION	REGULATORY AUTHORITY	REQUIREMENT	STATUS	DESCRIPTION
Discharge to Surface Water	Federal	National Pollutant Discharge Elimination System (NPDES)	Applicable	Regulates discharges of pollutants to surface water. Implementation has been delegated to the State of Ohio.
		Clean Water Act §304 40 CFR Part 130	Applicable	USEPA Publishes national recommended Ambient Water Quality Criteria (AWQC) for the protection of aquatic life and human health. A revised AWQC was developed by the USEPA for discharging treated water to the waterway following dewatering of sediment.
	State	Ohio NPDES Program	Applicable	As an authorized state, OEPA implements the NPDES program for regulating discharges to surface water (OAC Title 3745, Ch. 33).

Table 30: Cleanup Levels for Chemicals of Concern at the Allied Chemical and Ironton Coke Tar Plant (OU3) Site

Environmental Media	Site Area	COC	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
Soil	Main Parcel	benzo(a)pyrene	160 μg/kg	human health risk assessment	Cancer risk = 1×10^{-6}
	River Parcel	benzo(a)pyrene	160 μg/kg	human health risk assessment	Cancer risk = 1×10^{-6}
Sediment	Ohio River	total PAHs	$\sum$ESBTU = 10.0 or less	screening ecological risk assessment	toxicity to benthos equal to or less than upstream toxicity